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PERCEPTION OF NEEDS AND OPPORTUNITIES FOR IMPROVEMENT WITHIN AN INDUSTRIAL ORGANIZATION: SPECIAL EMPHASIS ON ITS RELATION TO STRUCTURE

A THESIS

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WITHIN AN INDUSTRIAL ORGANIZATION: SPECIAL EMPHASIS

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SUMMARY

The general purpose of this investigation is to provide insight into the process by which the management of an organization identifies the improvement needs of that organization. Improvement in this sense is any change which results in a better state of being for the system, with "better" indicating superiority in excellence, amount, or value. An improvement need can then be visualized as a condition or situation in the organization requiring satisfaction or solution through change. These are brought to the attention of management in several ways, one of which is the observance of problems, inefficiency, ineffectiveness, and similar indications of poor performance on the part of the organization. Another is in the observance of better systems, efficiency, effective techniques and similar indications of high performance being accomplished in other organizations or other systems.

It is the ability of the individual to observe these situations and relate them to his organization that is of prime importance in identifying improvement needs. The process required in making use of this ability is that of perception-cognition. The process is described as one in which the individual receives a large number of sensory inputs, or cues, from which he must reach some inference of identity concerning the situation under observation. Perception-cognition has at its core, the capability of the individual to reach verdical perception, that is, coding of these stimulus inputs into appropriate categories.

Verdical perception, in turn, has been shown to be highly dependent upon such factors as previous experiences, reinforcement history,

contemporary factors, and perceptual readiness. In relation to this investigation, this implies that a manager's perception of improvement needs for his organization should be influenced by these same factors, only in an organizational context. The specific objectives of this research are to examine an individual's (manager or professional) perceptions of improvement needs in an industrial organization in relationship to certain readily observable attributes of the individual. These attributes are in two general classes, individual and structural, which are intended to be measures of the individual and of his interface with the organization, respectively. Additional objectives deal with the relationship between preliminary feasibility evaluation of the identified needs and the individuals (top level managers) performing the evaluation, and with the general applicability of the study methodology.

The study was carried out in the manufacturing division of a medium sized industrial organization. The participants were selected by the organization and represented a cross-section of the departments composing the division. Data on the individual were gathered by questionnaire; data on the individual's perception of improvement needs were gathered by interview. Analysis of these data was performed by studying the agreement or lack of agreement between sets of need perceptions, where a set could represent the identifications made by an individual or the identifications made by a group of individuals. The groups were developed to represent classes of individual characteristics, such as classes by age, or they were developed to represent structural, both formal and informal, clusters of individuals.

Specific conclusions indicate very strong functional relationships between the individual and what improvement needs he perceives. The vertical location in the organization, however, seemed to have a much weaker influence. Informal structure had no influence on perception as measured in the study.

In terms of number of perceptions, the analysis demonstrated a relationship between age, managerial level and achievement index (a measure of progress up the organizational ladder). These results indicated that the best perceivers were either the individuals progressing rapidly up the ladder in the organization or the individuals already at the top.

Analysis of individuals having the same need perceptions resulted in identification of only two basic clusters of individuals in terms of what they perceived. One cluster was concerned primarily with people oriented problems, the other with technique oriented problems. However, because of the breadth of perception by the participants even these clusters are not unique. Factor analysis is introduced as a means of identifying clusters from among the individuals and substantiated the previous findings concerning the two basic clusters and the functional orientation. For example, Quality Control is shown to have a strong functional effect on its member's perceptions; Industrial Engineering members appear to have a very broad and extensive array of perceptions but ones which still tended to center around Industrial Engineering functions.

Analysis of the preliminary evaluation technique demonstrates that the scoring model used develops a set of ordinal values for the needs that is a very good composite of the whole evaluation team's ratings. The particular model used calculates individual evaluation as well as the composite evaluation and permits the comparison among individuals and with the composite. However, the composite does not identify, through high value being assigned, those needs given high ratings by only part of the team. It would be possible that lack of knowledge on the part of a portion of the team could eliminate a need that provides good opportunity for improvement. The conclusion reached is that if the evaluation of improvement needs at this early, preliminary stage is intended to permit selection of a set of needs that are to be studied in more detail, then this selected set should include needs that are given high evaluation by individuals as well as the composite. In addition to these conclusions, performance of this research activity indicated a number of areas where further research would be beneficial. These are identified in the study.

In general, the results of this study demonstrate the value of this approach to the process of improvement need identification in organizations. The appropriateness of the needs identified is evidenced by their reception by the organization. It can reasonably be expected that the approach could be applied to any improvement seeking organization.

CHAPTER I

INTRODUCTION

This is an exploratory study of the process by which an industrial organization may identify and give preliminary evaluation to its needs for improvement. From a theoretical viewpoint, this research is directed toward analyzing the results of this identification process, and the ensuing evaluation, with respect to the organization and the interrelationships among its members. The study was limited to one specific type of organization, but the problem studied is one that applies to any and all organizations as they continually search for ways in which to improve their attainment of goals and objectives.

It is often stated that the business organization's raison d'etre in our capitalistic environment is to maximize profit. Just as often, or perhaps more often, it is argued that this is not the situation. The argument takes the direction that pressures upon management force the organization to go about its operation in a manner that is something other than profit maximizing. Perhaps the most meaningful analysis is to draw an analogy to the natural law of survival of the fittest.

Through all of its activities, the business organization strives to survive. Its owners want it to survive; its employees want it to survive; its creditors want it to survive; and perhaps even its customers want it to survive. Peter Drucker (1) has identified a number of areas to which business organization objectives should be directed in order for that organization to survive. These can be modified to be more meaningful to organizations in general and so as to be indicative of the survival needs of an organization.

First, the organization must have a human structure designed for joint performance. It must be capable of perpetuating itself and expanding or contracting as might be required. Certainly, in a general sense, a fit organization is one in which the structure is well designed and one in which the organization has close control over the size of its membership.

Secondly, the organization has a need to interact with its economic and cultural environment. It must anticipate the social climate and act accordingly; for example, as present day industrial firms are taking action in regard to members of society classified as the "unemployable." In terms of the economic environment, which must also be anticipated, the activities of organizations to modify the laws of the land through lobbying activities in the legislatures are obvious actions to ensure the survival of these organizations.

The organization must have a purpose if it is to survive. This third survival requirement is that it must satisfy some need of the environment, specifically justifying its existence in that environment. Certainly the organization dedicated to the eradication of a specific disease, must, when that disease is eradicated, either disband or seek another objective if the organization is to continue; one can quote specific examples of this phenomenon.

But it is not sufficient merely to have a purpose that is significant to the environment in order to survive. The fourth survival need is that the organization must demonstrate progress and accomplishment. The business organization must be profitable and must grow to demonstrate accomplishment in the general sense. The non-profit organization must show success in achieving its objectives, whatever they may be. In either case, if society is going to permit the organization to exist, it must, in some sense, be successful.

The fifth survival need is that of improvement. Improvement is essential in the rapidly changing environment which organizations find themselves. If it is to be the fittest, it must be better than its competitor. To do this it must be constantly improving its activities because the competitor is doing just that. The need for improvement is also the result of the rapidly changing technology that the organization has available to it. From the operational viewpoint, this means there are improvement needs and opportunities that exist in relation to the manner in which the organization carries out its activities as a direct result of the development of new technology in these areas. From the product viewpoint, this means that the need exists for innovativeness in making use of new technology in the development and design of products.

Therefore, it can be logically stated that improvement is basic to the organization and its survival. Specifically, the term improvement relates to any change that results in the transition to a better state of being for the system. In this sense, a "better" state of being means a state of the system that is superior in excellence, amount, or value. This might be, for example, a more saleable product, lower employee turnover, improved morale, better management, lower operating costs, higher quality, better performance, etc. Any of these examples would herald this transition in an industrial organization; other examples might be appropriate to other types of organizations. The critical significance of improvement has been identified; it should be equally evident that improvement, being critical to the survival of the organization, must be considered one of the basic functions of the organization. If it is a basic function that is vital and returns handsome rewards, it deserves, or rather it requires, that it be managed as the other functions of the organization are managed. It is this explicit management of the improvement function that is required to assure that the opportunities for improvement are being exploited in an effective manner.

Basic to the improvement function in an organization is the identification of what improvement activities and projects are needed. Using the definition of a need as an existing condition that requires satisfaction, an improvement need is one in which satisfying this condition will result in a better state of being for the system. Second to the act of identifying improvement needs is the task of determining which of the set of improvement needs are feasible, timely, ready, etc., for satisfaction. Once the improvement opportunities are identified, the tasks of allocating available resources and implementing the specific improvement activities would follow.

The need identifying process is of prime interest as is the process by which the identified needs are given some preliminary feasibility evaluation in terms of opportunity. This activity is typically unstructured in organizations. It may be carried out informally by the management or experts may be brought in from the outside periodically to review certain areas or activities. The organization may attempt to compare itself with similar organizations, or it may establish a formal program of idea generation, such as in suggestion systems or any of the newer variants of them. Any or all of these are possible techniques. The one of particular interest is the process by which the management itself group identifies needs for improvement within their organization.

The process is vital; it may mean survival. The results of the process furnish work for a considerable portion of the organization's members, and, in turn, explains a similarly considerable portion of the organization's expenditures. All of this is dependent upon what management identifies as improvement needs and which of these it decides to allocate resources toward accomplishment. Because of this criticality and importance, the process is worthy of study and research; it has received little. It is toward the relief of this void that the present study is directed.

Objective

The purpose of this investigation is to develop concepts and investigate attributes of the general process by which improvement is managed in an organization. The management of improvement has been described as a vital function of the organization. It is a function that will benefit from the application of Industrial Engineering technology in the developing and understanding of the function's inherent characteristics and behavior. In actuality it is an extension of techniques requiring consideration of modern industrial engineering, operations research, organization theory, and behavioral science in order to generate an understanding of a process that is basic and vital to the organization.

The particular phase of the process of management of improvement that is studied is that phase related to the identification of improvement needs. It is another purpose of this study to provide specific insight into the processes of improvement need identification and the preliminary evaluation of these needs by the management of an industrial organization.

The process is one of utilization of the perceptive-cognitive capabilities of managers and professional people within the organization to identify how or where the organization should improve. The preliminary evaluation process makes use of these same capabilities in a situation of evaluation under the handicap of severely limited knowledge.

Specific Objectives of this study are:

1. Development and implementation of a methodology for studying and evaluating the process in a specific organization.
2. Evaluation of the process in terms of the characteristics of the individual participating in the study.
3. Evaluation of the process in terms of formal and informal structures of the organization.
4. Evaluation of the preliminary feasibility evaluation technique in terms of the individuals carrying ont the evaluation.
5. Identification of characteristics of the process that have general application outside of the particular industrial environment studied.

Scope and Limitations

The study has been performed in a specific industrial environment. This obviously tends to limit the general applicability of specific results. But the general results of this research should have wide applicability to organizations and the study of organizations. Its most obvious general application is to any organization professing an active interest in better management of its improvement function.

The study was faced with several constraints which also have an effect on the nature of the results. Not all of the management and professional members of the organization participated; the number was limited by the time available for interviewing by the researcher and the availability of participants as determined by the organization. Also, the evaluation process and the time required limited the number of improvement needs that could be handled; therefore, in some areas, needs identified were grouped into composite classes of similar description. This technique reduced the dimensionality of the problem and tended to increase the similarity between two members in terms of the needs perceived. These limitations are felt to be minor in their effect upon the overall results of this study.

CHAPTER II

PERSPECTIVE

Organizations are generally thought of as groups of two or more people working toward some common goal. It is this goal or objective which provides the incentive for their activities as a group. To say that organizations are essential to human existence as we know it is banal. But it is because of this essential importance that a great deal of effort has been expended in trying to understand the underpinings of organizations and of the behavior of humans when working within organizations.

A number of theories on organizations and organizational behavior have developed. Notable surveys are Rubenstein and Haberstroh's <u>Some Theories of Organization</u> (2) and McGuire's <u>Theories of Business Behavior</u> (3). While it is beyond the scope of this study to present or evaluate any of these studies, a definition of an organization will be useful. Lorsch (4) gives the following which can be used for a working definition:

> Any organization can be usefully conceived of as a socio-technical system in which behavior is influenced by a number of interrelated variables, including the individual predispositions of members, social structure, formal organization, and the system's external environment. Organizational systems are involved in constant transactions with their technical and market environment, and the strategy adopted to cope with this environment becomes the organization's primary task. Each system has a number of units that can be conceived of as socio-technical subsystems. Behavior in each of these units is influenced not only by its structure and the predisposition of members, but also by the internal environment of the system of which it is a unit and by the

external market and technical environment with which it must cope.

This definition has particular applicability to this study because it stresses the influence of the members themselves and of the social structure which is a result of the interaction among the members. The formal organization and the external environment can be fairly well defined, but it is the previous two variables, as Lorsch identifies them, that may present the more significant problems to the organization. The formal organization is completely within the control of the organization, the external environment completely outside the control of the organization. The predisposition of members and the social structure, however, while outside the realm of direct control, can be influenced to a large extent by the organization and the manner in which it is managed. The state of these two variables, in a general sense, determines the action and reaction of the organization to both internal and external stimuli and in turn has a significant effect upon success. These two variables can be seen to have a considerable effect upon what action the organization undertakes in regard to its improvement needs.

Organization theories have usually discussed improvement under two other terms, which, while not identical, are similar: change and innovation. Improvement in the sense that it will be used in this study is more restrictive than the word "change," for it implies a specific direction to change. It also implies a broad scope of directed change, broader than the scope usually attributed to innovation. Use of this term has generally been restricted to new product activities (5,6,7). Because of these more common usages, the term improvement is preferred and will be used in the manner of the definition given in Chapter I.

The literature of improvement in organizations is directed toward the problems associated with carrying out change activity within the organization. These problems discussed are primarily ones of implementation and are a result of the effects of change on individuals and individual behavior. Robert T. Hershey, a Vice President of Du Pont, in a presentation titled "The Management of Change: A Personal View," identified the most crucial factor in change as being people, and not things (8). Warren G. Bennis of MIT is more thorough in his identification of the problems of changing organizations (9):

Identification of appropriate mission and values
Human collaboration and conflict
Control and leadership
Coping with, and resistance to, change
Utilization of human resources
Communication between hierarchical ranks
Rapid growth
Management and career development.

The people orientation is obvious, however, in his list. A. S. Judson, a consultant, in his book A Manager's Guide to Making Changes also devotes almost all of it to people problems, with such chapters as "Prediction of the Extent of Resistance (to change)" and "Minimizing Resistance to Changes: Concepts" as well as one similarly titled but directed toward Methods (10). Robert N. Lehrer, in his book The Management of Improvement: Concepts, Organization, and Strategy, summarizes these thoughts by titling a chapter "The Key - The Human Factor" in which he identifies the critical nature of the people problem to the whole of the improvement effort (11).

From this brief survey, it can be seen that management, academia, and the management consultant recognize the change problem as being a people oriented problem. All of the referenced works are business oriented, that is, they are concerned primarily with change in business organizations. But the problem is not one limited to business. People resist change and the unknown in any environment, for any number of reasons. The authors of The Dynamics of Planned Change, Lippitt, Watson, and Westley, take a much more general view of change and the individual (12). They identify the process as planned change and that it occurs in a client system with the aid of an outside agent, termed the change agent. The client system can take on any identity. The authors specify four; the personality (the individual), the group, the organization, and the community, as dynamic client systems which have the same basic structure in carrying out change in their makeup or activities.

The following quotation describes their concept of planned change which effectively parallels the previously stated idea of improvement being necessary because of technological and environmental change:

> As new internal or external situations arising from the innovation forces as we have mentioned confront the personality system or the social system, the system itself is challenged to change its structure or its way of functioning in order to cope more effectively with the changed state of affairs. These changes toward the good (that is, effectiveness, adjustment, painlessness) or away from the bad (that is, ineffectiveness, maladjustment, pain) may come about in a number of ways. The system may mobilize its resources to improve and correct its own operations or structure. In other words, it may take matters into its own hands. Or the normal processes of maturation and development may result in the spontaneous evolution of change from within the system. Or the system may escape its problem by moving to a new situation where its present method and structures are better adapted to the environment. Or changes in the external environment may actually serve to solve the system's problems instead of creating new ones. A shift

> in the regional economy, for instance, may produce a better local employment market and reduce intergroup tensions, thus solving the problems of a local business firm. All of these types of changes can be classified in this analysis of change processes as either spontaneous, developmental changes within the system or fortuitous, unplanned changes outside the system. These are quite different things from the type of change which we want to discuss in this book: the <u>planned change</u> that originates in a decision to make a deliberate effort to improve the system and to obtain the help of an outside agent in making this improvement. We call this outside help a <u>change agent</u>. The decision to make a change may be made by the system itself, after experiences pain (malfunctioning) or discovering the possibility of improvement, or by an outside change agent who observes the need for change in a particular system and takes the initiative in establishing a helping relationship with that system. (12)

It is obvious that Lippitt, et al., have a concept of planned change which closely matches the ideas presented here under the identification of improvement. The only meaningful difference is their reliance upon an outside agent, a change agent, to help in the performing of improvement activities. A restriction of this nature is not warranted and will be discussed in more detail later.

The conclusion that can be made at this point in the development of this perspective of improvement is that improvement is widely acknowledged to be important to the organization. Its critical nature has been established in Chapter I, while the general recognition of the problem of improving or changing has been established in the preceding paragraphs. It is logical that the process by which improvement is carried out in an organization be examined next.

<u>The Improvement Process</u>

Chris Argyris in <u>Organizational Development</u> presents the diagram shown in Figure 1 which describes a specific change program in a large corporation when examined in retrospect (13). The program was initiated

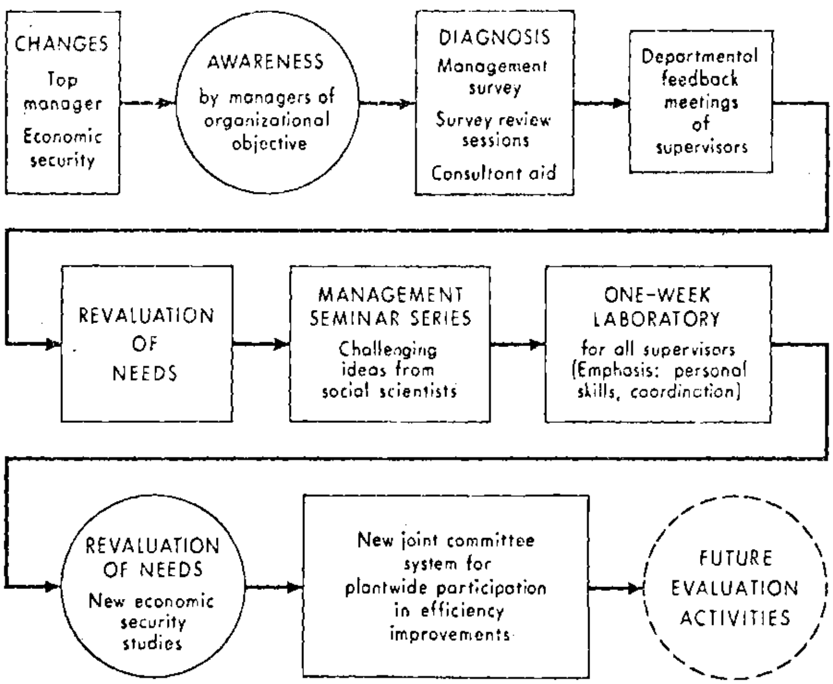


Figure 1 Improvement Process Example (13)

after top management's recognition of the need for improved operations at one of their smaller facilities. From the diagram it can be seen that after changing the top manager at the facility, the program went through cycles of studying the needs, seeking assistance and taking action. The assistance sought could be described as the services of a change agent; the identification of the client system is obvious. Also, the tasks of diagnosis of problems and persistent re-evaluation can be seen in the cycles. This is a specific improvement process or method, the steps that were followed in carrying out an improvement activity.

A different set of steps or phases in this process of change is presented by Kenneth D. Benne in Lawrence and Seiler's Organization Behavior and Administration (14):

1. Diagnosis of the Problem of the Client System. What is the trouble and what seems to be causing the trouble?
2. Assessment of the Motivation and Capacity of the Client System to Change Itself. What are the readinesses and resistances to various possibilities of change within the client system?
3. Assessment of the Motivations and Resources of the Change Agent. Why does the change agent want to help the client, and what are the practical, ethical, psychological, sociological, and other limits of his ability to give help to a particular client system?
4. Selecting Appropriate Change Objectives and Targets. Of all the possibilities of change, which are most important and within the power of the client to accomplish; and which is, all things considered, the best first step to take in an experimental attempt to change?
5. Choosing the Appropriate Type of Helping Role. Shall the change agent mediate or counsel? Demonstrate or encourage? Represent some wide reality to the client system or support the client in its or his peculiar view of reality?
6. Establishing and Maintaining a Working Relationship with the Client System. How to get a mutually acceptable and commonly understood picture of the responsibilities of the change agent and of the client in the client's efforts to solve its (or his) own problems.

7. <u>Termination (or New Continuity) of Helping Relationship</u>. When and how does the change agent pull out and leave the client on his own?
8. <u>Choosing Appropriate Specific Behaviors and Techniques for Giving Help</u>.

Benne's phases emphasize the role of the change agent and his related writings emphasize the change agent's part in the diagnosis phase. This author also brings to the forefront the idea that the change agent should recognize his own motivation in seeking to help the client system. He assumes the existence of outside change agent and implies that the success of the improvement process is highly dependent upon the relationship that exists between the change agent and the client system. His phases also imply that these are all problems for the change agent to evaluate and solve. In general, Benne de-emphasizes the client system's part in the improvement process and strengthens the part that the outside expert, the change agent, plays in improvement activities. While the specific points that he makes are important, his general assertion is deficient and cannot be accepted in toto.

Benne's approach is highly influenced by the set of phases proposed by Tippitt, et al., (12). These authors have proposed the following:

Phase 1: The client system discovers the need for help, sometimes with stimulation by the change agent.
Phase 2: The helping relationship is established and defined.
Phase 3: The change problem is identified and clarified.
Phase 4: Alternative possibilities for change are examined; change goals or intentions are established.
Phase 5: Change efforts in the "reality situation" are attempted.
Phase 6: Change is generalized and stabilized.
Phase 7: The helping relationship ends or a different type of continuing relationship is defined.

These phases provide a much more uniform and all encompassing approach to the definition of an improvement process. However, these authors also stress that the change agent has to be from outside the client system. Obviously this is not an acceptable limitation from the viewpoint of an industrial organization; it must carry out at least some of its improvement activities by itself, without outside agents or consultants.

As a final review of some of the improvement processes proposed in the literature, the recommendations of a consultant can be considered. Judson proposes the following steps (10):

a. Analysis and Planning the Change

> The analysis and planning phase of a change should be completed before any overt action is taken actually to institute it. With such preparation, management can improve the probability of acceptance of the change by those on whom its ultimate success is most dependent.

b. Communicating About the Change

> The principal function of communications phase is to enable those involved (and the union) to accustom themselves to the idea that a change is needed, and that it will soon be taking place. By the latter stages of the communications phase, all concerned should understand why the change is necessary, what is to be achieved, what are some alternative methods of approach, and what are the more important problems that might result from each of these alternatives. Thus, at the close of the communications phase, they should be close to agreement on the most desirable method for accomplishing the change.

c. Gaining Acceptance of Required Changes in Behavior

> In most changes, the manager should begin the transition from the *status quo* to the new conditions only after a consensus of agreement has been reached about the method of this transition.

d. Making the Initial Transition

> The transition from the *status quo* to the new conditions beginsonly after some agreement has been reached on the method of change. Full benefit can be gained from the contributions of staff specialists by involving them deeply in the planning and conduct of the change.

e. Consolidation and Follow Up

To ensure that full benefits from a change are realized the manager must institute systematic and thorough follow-up procedures. He must ensure that both the results of the change and the way in which they were achieved are evaluated completely and objectively. The manager can himself contribute greatly to success if he remains flexible about changing the methods used for realizing the change.

There are some basic differences in these sets of phases to the improvement process as these authors describe it. As mentioned earlier, both Benne and Tippitt, et al., presuppose that the change agent is an outsider. Others, including the other two presented here, identify that the change agent can be someone in the organization. The argument for the first is that the significant change requires the impetus generated by an external person; only a skilled outsider can provide the necessary detachment to effect alleviation of existing patterns. The other argument that runs counter, states that intimate knowledge of the client system is a necessity and that an insider may not generate the suspicion and mistrust that an outsider might. As an example, General Electric, in its change program uses internal change agents; however, with the restriction that these internal men are not placed on project assignments within their own departments (9).

There are also differences in the set of phases in terms of where the process begins and ends. A diagram comparing the four sets is shown in Figure 2. In this figure the columns represent a set of phases or steps to achieving or carrying out improvement. They are identified by the column headings:

Recognition of Improvement Need
Establishment of Improvement Relationship
Diagnosis of Improvement

RECOGNITION OF IMPROVEMENT NEED	ESTABLISHMENT OF IMPROVEMENT RELATIONSHIP	DIAGNOSIS OF IMPROVEMENT	DEVELOPMENT OF STRATEGY	IMPLEMENTATION OF IMPROVEMENT	STABILIZATION OF IMPROVEMENT	FOLLOWUP AND/OR CLOSURE
AWARENESS-by managers of organizational objective REVALUATION OF NEEDS-New economic security studies	Consultant aid	DIAGNOSIS-Management survey Survey review sessions	Departmental feedback meetings of supervisors MANAGEMENT SEMINAR SERIES-Challenging ideas from social scientists ONE-WEEK LABORATORY for all supervisors (Emphasis: personal skills, coordination)	New joint committee system for plantwide participation in efficiency improvements		FUTURE EVALUATION ACTIVITIES
	Establishing and Maintaining a Working Relationship with the Client System	Diagnosis of the Problem of the Client System Selecting Appropriate Change Objectives and Targets	Assessment of the Motivation and Capacity of the Client System to Change Itself Assessment of the Motivations and Resources of the Change Agent Choosing the Appropriate Type of Helping Role Choosing Appropriate Specific Behaviors and Techniques for Giving Help			Termination (or New Continuity) of Helping Relationship
The client system discovers the need for help, sometimes with stimulation by the change agent	The helping relationship is established and defined	The change problem is identified and clarified	Alternative possibilities for change are examined; change goals of intentions are established	Change efforts in the "reality situation" are attempted	Change is generalized and stabilized	The helping relationship ends or a different type of continuing relationship is defined
			Analysing and Planning the Change	Communicating about the Change Gaining Acceptance of the Required Changes in Behavior Making the Initial Transition		Consolidation and Follow Up

Figure 2 Improvement Process Phases

Development of Strategy
Implementation of Improvement
Stabilization of Improvement
Follow up and/or Closure

The rows represent each of the previously discussed authors' sets of phases, but arranged in such a manner as to fall in the column of the overall improvement process (in the headings) that it most closely matches. There are similarities (primarily with Tippitt, et al.) but also some differences that justify the improvement process as defined by the column headings of Figure 2, as being a reasonable and meaningful description of the steps that an organization accomplishes in carrying out improvement activities. There are some characteristics of the improvement activities in industrial organizations that make the proposed steps particularly appropriate.

In the first phase, recognition of the need for improvement is an obvious starting point. In the industrial organization, a manager must recognize that something is a problem or that something can be made better. If it is a large improvement, perhaps a whole hierarchy of managers must concur in this recognition. The idea may originate with virtually anyone in the organization, but the concurrence of management is required before action will be taken in the industrial organization. The idea may be brought to management's attention by someone external to the operation, but management must accept this outside viewpoint before it will take even token action. In an autocratic organization, recognition may be forced by higher management; in a more democratic organization, a problem may exist and be specifically ignored by higher management, waiting for the responsible manager to recognize and initiate action.

Recognition may also come about by a change agent's bringing it to the client system's attention. This might be in an effort to bring about better operation of the system (a worthwhile motive), or in an effort to promote and expand his services (possibly a questionable motive). Tippitt, et al., suggest another possibility (12). They point out situations where a third party brings the improvement need to the attention of both the client system and the change agent. An obvious industrial example is an action taken by a bank in bringing a consultant together with one of its commercial customers experiencing some particular difficulty which affects the customer's financial position. Regardless of the specific manner of recognition, it is obvious that it is a requirement that recognition must take place along with the preliminary evaluation of the need as being worth pursuing before any further action can be taken.

Once the client system has recognized there is a need for improvement, it must determine how it will go about satisfying that need. The decision to be made first is whether or not the system can handle the improvement itself or whether it must seek external assistance, which might be found in another unit of the same organization or might be completely outside of the particular organization. The differentiation here is between change agents like the company Operations Research department and an outside Operations Research consultant, for example. In this phase of the process, both the client system and the change agent must develop an understanding of each others motives and capabilities, as well as their own. The client system is concerned with the capability of the change agent and with his preliminary evaluation of the situation. The change agent may be concerned with the client system's sincerity in seeking change and the extent to which he will cooperate and assist the improvement activity. Essentially this phase is one of mutual evaluation of capability and of building trust and confidence. It will be affected to a large degree by past experience if the two parties have had previous contact. Benne points out the importance of the change agent evaluating his position in relationship to the client system and the specific change before proceeding (14).

Once the change agent-client system roles have been established, the change agent is faced with the task of diagnosing the improvement need situation. Very specifically, up to this point, the change agent would ordinarily have had only a superficial look at the problem or need. Now he is faced with a data gathering and analysis activity to make it possible for him to determine the actual need in very specific and definitive terms. He may be faced with determining if the need can be satisfied, that is, does an opportunity for carrying out this improvement activity really exist. The alternative here is that the need exists, but the situation or technology is such that now is not the proper time to apply resources toward solution. It is at this phase that the two parties must decide upon the specific improvement objective sought. It goes without saying that mutual acceptance of this goal is essential. Tippitt, et al., point up in their work that this phase may be highly critical to the whole of satisfactory completion because it is at this point that vested interests in the organization become aware of the pending change (12). They may interpret the change as a threat and their defensive action may destroy the improvement activity or seriously limit its effectiveness.

With the establishment of an agreeable and meaningful objective, the change agent must develop possible solutions and strategies for reaching the objective and must select one as the most feasible. This selection step will probably be a joint decision by the client system and the change agent. However, it is highly influenced, perhaps even controlled by the change agent. As Galbraith points out in a very similar context, the manager may make the final decision between two or three alternatives presented to him, but the selection of the alternative has been done by their supplier, in this case the change agent (15). In many situations the development of a successful strategy entails considerable cooperation between the two parties. Here the client system must provide the knowledge of the system and how it reacts to change while the change agent provides technical expertise.

Implementation of the selected strategy is then undertaken. This is the focal point of the whole of the improvement process. Difficulties encountered will be the resistance to change by portions of the client system and associated systems. In the change processes previously discussed, this is identified as the critical phase in terms of their authors' emphasis. Judson, for instance, devotes most of his book to techniques for overcoming this resistance and motivating people to accept change (10). Recent articles in technical journals have also emphasized the importance and problems of implementation from the change agent's viewpoint (16, 17).

Assuming satisfactory implementation, it then becomes necessary for the change agent to take specific action to assure that the improvement is permanent. In an industrial organization this usually means documentation of the improvement and development of operating standards and procedures. Specifications of this nature tend to prevent the client system from getting off course or slipping back in the activities affected by the improvement. This phase may entail training of client system personnel to take over some of the activities of the change agent so that the improvement can continue unimpeded. The stabilization phase also starts the removal of the change agent from operation of the improved system. This transition reaches its final stage in the last phase, titled Follow-up and/or Closure.

This last phase may take two directions, both preceded by a point of mutual agreement. First there must be this agreement between the client system and the change agent that the objective has been reached in its entirety or sufficiently close enough to warrant discontinuance of the current activity. At this time a decision can be made as to the change agent's role in future activities of the client system. It may be, as in Argyris's example, that periodic re-evaluation and follow up are required. Perhaps the relationship can be closed out completely. Whichever situation exists, it is of vital importance that this phase be performed. If the closure is satisfactory, it serves to strengthen the relationship between two parties. As a result, the client system will have a ready source of assistance when it again encounters an improvement need. Likewise the change agent will have a ready source of clients if the transition has been made smoothly and satisfactorily. The net result is to aid in the second phase of the process, establishing an improvement relationship.

It has been shown that there is a process or series of steps that can be used to identify or describe the activities that an organization goes through when seeking improvement. The proposed phases are meant to be general and not necessarily sequential. Examples can be recalled that may not follow the sequence or may include a loop that includes several of the phases. The purpose of this development is to demonstrate that recognition of needs is an essential part of carrying out the improvement function of an organization. With this conclusion, it is possible to consider in more detail the techniques by which this particular phase may be accomplished.

Need Identification Process

As has been stated previously, this study is concerned with the process and results of identifying improvement needs. The basic data that were gathered were the needs identified by the members of the organization and the subsequent preliminary evaluation of these ideas by a management group. The original source of the need identification was not determined. It was the fact that the individual perceived that the item being identified was in reality an improvement need for his organization that was the important criterion. This act of identification is a process that can be classified as one of perception-cognition.

Perception, as defined by Jerome S. Bruner, involves an act of categorization and as such cannot effectively be considered without or separately from cognition (18). The categorization takes place on the basis of certain defining or criterial attributes in the perceptual input which can be called cues. These attributes and their resulting categories can be extremely simple or complex. Perception of hot or cold involves a simple set; the perception of organizational problems entails a very complex set of attributes and categories. Figure 3 shows that the process of categorization is accomplished by first determining the large class of problems in which the perception belongs and then examining intersections with other known classes of problems until the categorization reaches a level where the individual can no longer perceive differences or no longer has categories for the differential aspects of the perception.

Bruner makes the following propositions concerning this view of perception (18):

> <u>The first is that perception is a decision process</u>. Whatever the nature of the task set, the perceiver or his nervous system decides that a thing perceived is one thing, and not another. A line is longer or shorter than a standard, a particular object is a snake and not a fallen branch, the incomplete word L*VE in the context MEN L*VE WOMEN is the word LOVE and not LIVE.
>
> The second proposition is that <u>the decision process involves the utilization of discriminatory cues</u>, as do all decision processes. That is to say, the properties of stimulus inputs make it possible to sort these inputs into categories of best fit.
>
> Thirdly, <u>the cue utilization process involves the operation of inference</u>. Going from one cue to inference of identity is probably the most ubiquitous and primitive cognitive activity. The utilization of inference presupposes the learning of environmental probabilities and invariances relating cues to cues and cues to behavioral consequences. Cue utilization involves various stages: a primitive step of isolating an object or event from the flux of environmental stimulation, stages of cue searching where the task is to find cues that can be fitted to available category specifications, a tentative categorization with more search for confirming cues, and final categorization, when cue searching is severely reduced.

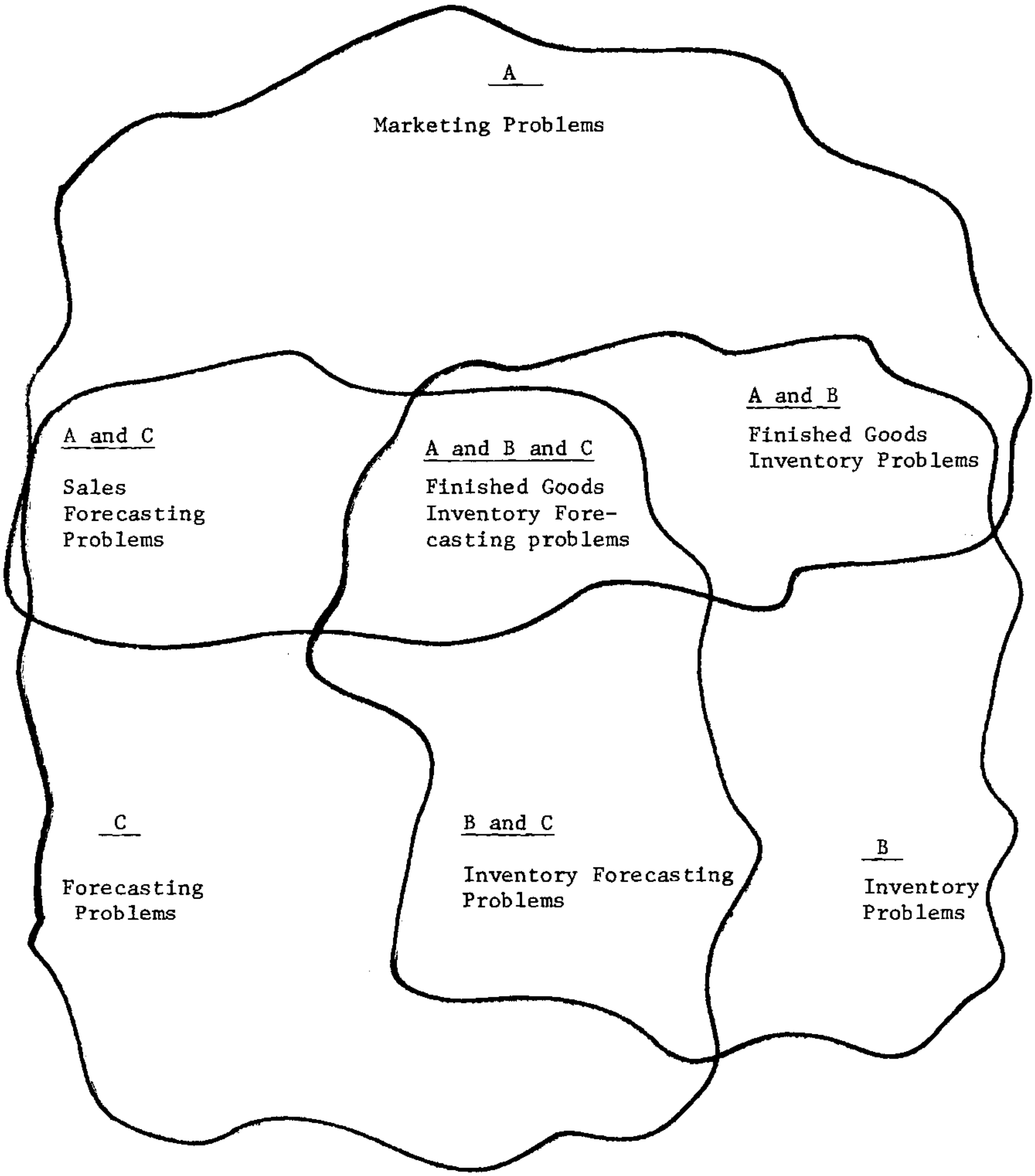


Figure 3 Perceptual Categorization of a Problem

Fourth, <u>a category may be regarded as a set of specifications</u> regarding what events will be grouped as equivalent-rules respecting the nature of criterial cues required, the manner of their combining, their inferential weight, and the acceptance limits of their variability.

Fifth, <u>categories vary in terms of their accessibility</u>, the readiness with which a stimulus input with given properties will be coded or identified in terms of a category. The relative accessibility of categories and systems of categories seems to depend upon two factors: the expectancies of the person with regard to the likelihood of events to be encountered in the environment; and the search requirements imposed on the organism by his needs and his ongoing enterprises. To use the functionalist's language perceptual readiness or accessibility serves two functions: <u>to minimize the surprise value of the environment</u> by matching category accessibility to the probabilities of events in the world about one, and <u>to maximize the attainment of sought-after objects and events</u>.

<u>Verdical perception</u>, so our sixth proposition would run, <u>consists of the coding of stimulus inputs in appropriate categories</u> such that one may go from cue to categorial identification, and thence to the correct inference or prediction of other properties of the object so categorized. Thus, verdical perception requires the learning of categories and category systems appropriate to the events and objects with which the person has commerce in the physical world. When we speak of the representative function of perception, we speak of the adequacy of the categorizing system of the individual in permitting him to infer the nature of events and to go beyond them to the correct prediction of other events.

Seventh, <u>under less than optimal conditions, perception will be verdical in the degree to which the accessibility of categorizing systems reflects the likelihood of occurrence of the events that the person will encounter</u>. Where accessibility of categories reflects the environmental probabilities, the organism is in the position of requiring less stimulus input, less redundancy of cues for the appropriate categorization of objects. In like vein, nonverdical perception will be systematic rather than random in its error insofar as it reflects the inappropriate readiness of the perceiver. The more inappropriate the readiness, the greater the input or redundancy of cues required for appropriate categorization to occur - where "appropriate" means that an input is coded in the category that yields more adequate subsequent prediction.

If this is accepted as a description of the perceptive-cognitive process by which an individual might identify improvement needs, then it is of importance to determine what affects the act of verdical categorization. Secord and Backman, in a book on social psychology identify several basic processes affecting perceptual response (19):

> 1. The selectivity of perception and characteristic ways of organizing stimulus patterns. At any given moment, the perceiver responds to only a small portion of the sensory information provided by his environment, and he organizes it in certain ways.
>
> 2. The frequency of previous experience with particular stimulus patterns and responses. Later perceptions are affected by these previous experiences.
>
> 3. Experiences with stimuli and responses that have been positively or negatively reinforced. This reinforcement history also influences later perceptions.
>
> 4. The contemporary factors prevailing at the moment of perception. Certain current conditions, such as hunger, fatigue, or anxiety, may affect what is perceived.
>
> 5. Indicators of perception. A person's sensory experiences cannot be directly observed by the scientist; thus, his conclusions about perception are partly a function of the indirect means he uses to study it.

These are in general agreement with other authors in the field of psychology, for example, Kai von Fieandt's The World of Perception. (20) All of these can be directly related to situations in the industrial organization environment.

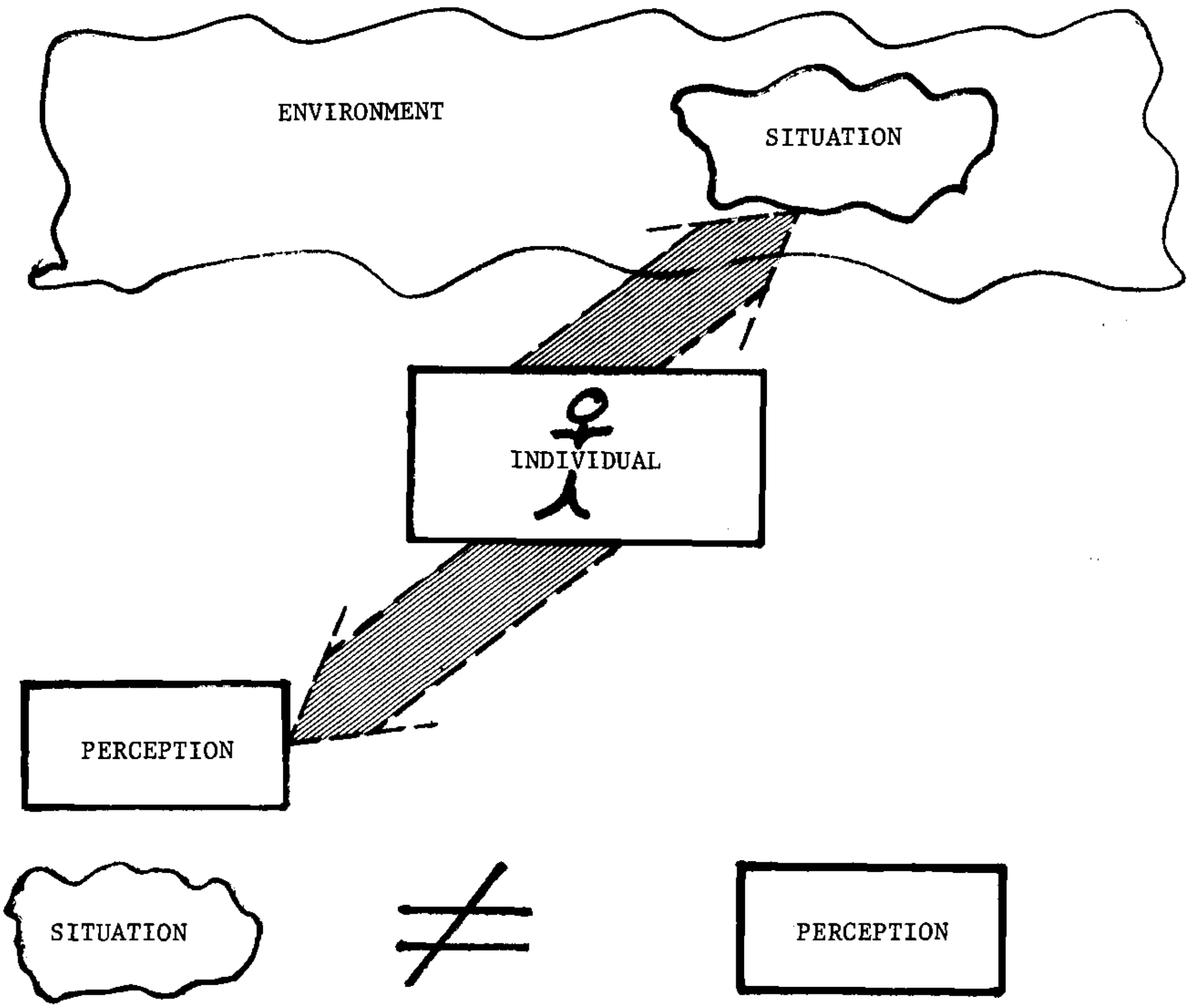
Bruner also looks at mechanisms that control the categorizing phases of perception (18). He specifies Grouping and Integrating as a process of combining cues to effect categorization. Access ordering, affected by instruction, past learning, and motivation, is determined by subjective probability estimates of the likelihood of a given event and the particular search set used as induced by the behavioral or motivational state of the individual. Match-mismatch processes are controlled by past learning and determine whether or not the stimulus is accepted in a particular category. Gating processes are proposed as a filtering process where extraneous or perhaps individually undesirable stimuli are blocked, lost, or in some way prevented from being categorized and therefore perceived.

From this limited discussion of perception-cognition, it is possible to infer that this is the process that makes it possible for an individual in an organization to identify certain situations as improvement needs. It is also possible to infer factors that might have a measurable effect upon the individual and how he perceives the need for improvement. The individual in this environment witnesses untold numbers of situations and occurrence stimuli. Based upon characteristics of this individual, he will perceive some of these as constituting situations that are undesirable for the organization and hence, a need for improvement. The basis may be one stimulus or perhaps a series of stimuli over a period of time which tend to promote and strengthen their categorization. The final disposition of the stimuli result in the perception.

In the environment of the type studied, this disposition may be affected by the education of the individual, his age, his motivation, and his areas of interest and other attributes of the individual as an individual. The disposition is also affected by the attributes of the individual in the social structure of the organization, his level, his function and area of responsibilities, his formal and informal contact with fellow members of the organization. Still a third area of activity which affects this disposition is social and technical inputs from outside the environment. These are the types of controlling and modifying factors which will be studied in analyzing the perception of improvement needs by one particular group of individuals in a particular organization.

A general schematic diagram of the process is shown in Figure 4. The perception-cognition process of the individual serves to filter reality to a degree determined by the individual, his background, and other characteristics described in the illustration. Two alternatives are available for improving the correspondence between the situation in reality and the situation as perceived. One is to select individuals who respond correctly to stimuli from the situation. The other is to modify the perceptual readiness (as Bruner (18) identifies it) of the specific individuals by training, motivation, and other means.

This study is aimed at examining this process and its results in an industrial environment. Specifically, the effect of the before mentioned characteristics upon the categorization of perception will be examined in considerable detail.



BECAUSE OF INDIVIDUALS:

BACKGROUND, EDUCATION, EXPERIENCES, ETC
MOTIVATION, CONTEMPORARY FACTORS, CURRENT CONDITIONS
AMOUNT OF OTHER PERCEPTUAL STIMULI, AND SELECTIVITY
PREVIOUS PERCEPTUAL EXPERIENCE, FREQUENCY
REINFORCEMENT HISTORY, ETC

Figure 4 Perception Process Schematic

CHAPTER III

GENERAL METHODOLOGY

The Research Environment

The research environment was an industrial organization located in a small city. This particular organization is a manufacturer of major home appliances and has been extremely successful in this endeavor over a number of years. The company has three production facilities, two at the headquarters location, and one smaller plant, approximately sixty miles away. Employees number nearly 3,700. Its product line is quite narrow and as a result the company has exhibited significant vertical integration in its manufacturing operation. The organization and its management is known for its conservatism and its success. The formal organization is shown in Figure 5.

The Manufacturing Division of the company was selected as the specific portion of the company in which the study would be carried out. There were two reasons for this; the organization was particularly interested in this approach to defining improvement needs and working with this organization resulted in a study environment of manageable size with a specific responsibility and a specific, though undefined, set of goals and objectives. The Manufacturing Division's formal organization chart is shown in Figure 6. Within the Division are three plant managements, which, along with their respective production control groups, report to a Manager of Manufacturing who in turn reports to the

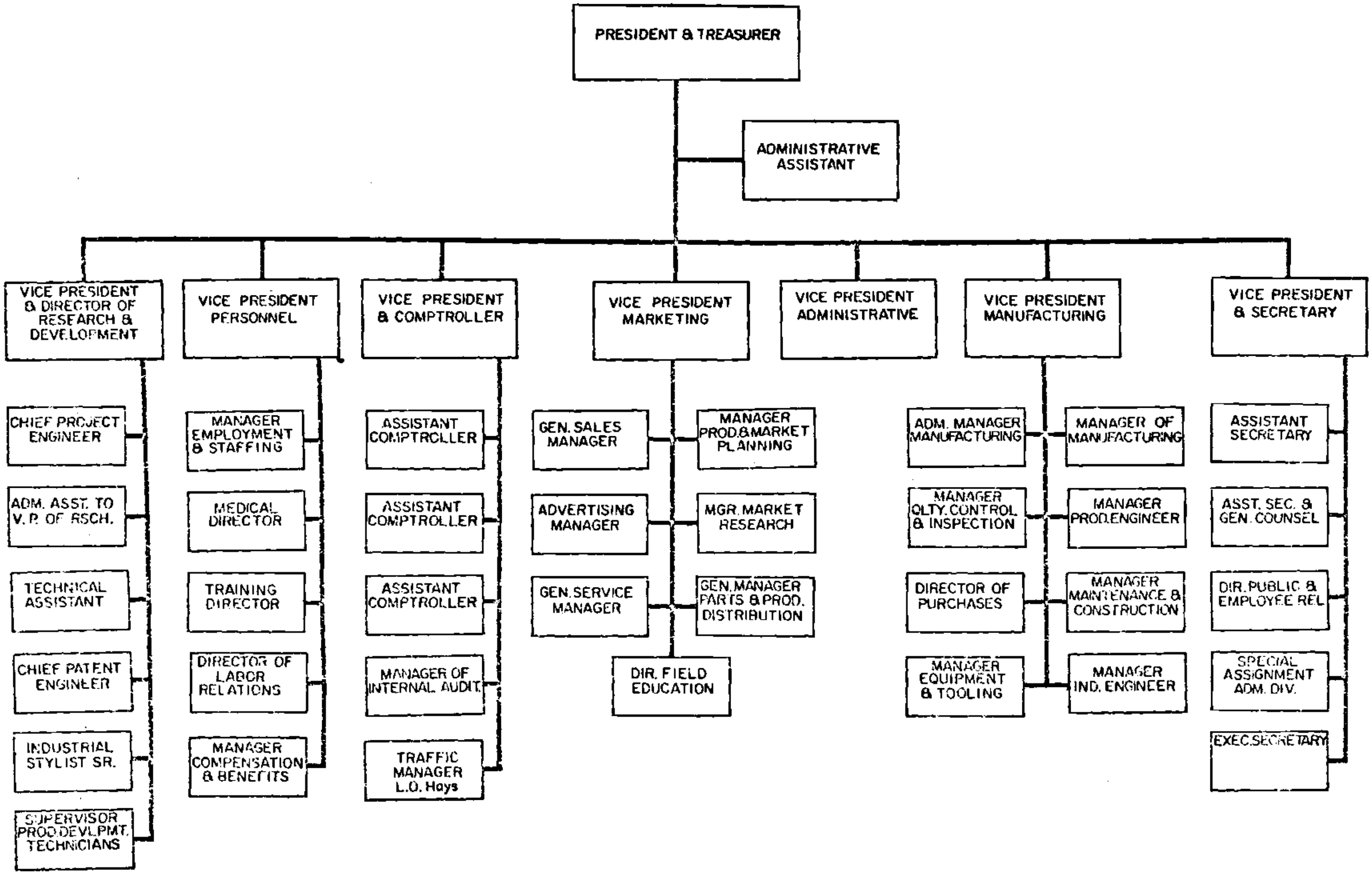


Figure 5 Company Organization Chart

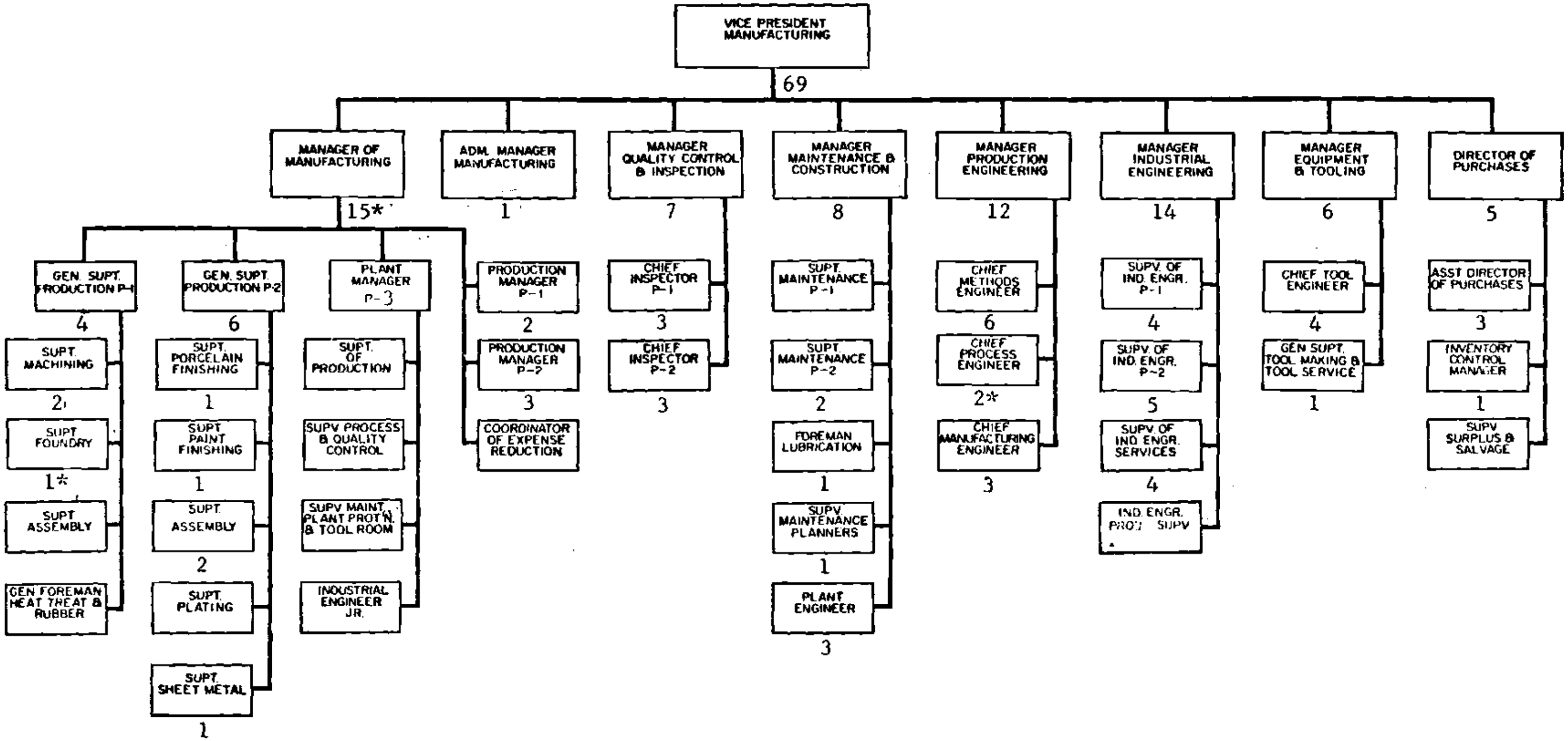


Figure 6 Manufacturing Division Organization Chart

Vice President-Manufacturing. During the study the Manager of Manufacturing was on a special assignment; as a result this responsibility was handled by the Administrative Manager-Manufacturing who was designated the Acting Manager of Manufacturing. It should also be noted that Plant Number Three (P-3) was the small remote facility and was not included in the study.

Other managers who reported to the Vice President are in charge of Quality Control and Inspection, Maintenance and Construction, Production Engineering, Industrial Engineering, Equipment and Tooling, and Purchasing. The last is designated the Director of Purchases while the others are titled Managers of their respective functions.

The specific study participants were selected from the managerial and professional ranks within the Manufacturing Division. The Vice President-Manufacturing and all the men reporting directly to him were included, as were 76 percent of the men reporting to this top group. The remaining 42 participants (from the total 69 who took part in the study) were from other levels in this same organization. The number below each position in Figure 6, indicates the number of people in that organization, including the individual in the position, who participatedin the study. An asterisk indicates that the person in the position did not participate but people in his organization did. Appendix 1 provides a complete organization chart with each participant identified by his Participant Number, a non-significant identifier assigned randomly to facilitate analysis and reporting of results. Additional data on each participant, organized by Participant Number is found in Appendix 2.

Data Collection

In total, 69 members of the manufacturing organization took part in the study. The data collection was carried out by means of questionnaire and interview. The questionnaire, shown in Appendix 3 provided information on the individual's background, education, interpersonal contacts, etc. Of the 69 questionnaires furnished, 65 or 94 per cent were returned. The interview was held after an initial group session in which the purpose of the study was explained and the general topic of improvement management introduced. The interview was unstructured, and after initial familiarization with the topic, the individual discussed any improvement situation or needs that he desired. For facilitating the interview and group session approaches as well as permitting emphasis on certain levels of the organization, the participants were divided into four groups, identified as Groups A, B, C, and D.

Group A included the Vice President-Manufacturing and all seven managers who report directly to him. An eighth manager, on special assignment, was not included in the study. Contact times with this group averaged as follows:

Group Session (Introduction)	1 1/2	hr.
Individual Session (Introduction)	1	hr.
Individual Session (Interview)	2	hr.
Individual Session (Interview)	1	hr.

The first individual session was designed around developing a set of predictions of the future which could be used to provide a common ground for perception of improvement needs. After this set of predictions, which included some differences of opinion (Appendix 4) was developed, it was presented to all participants for evaluation at the beginning of an individual interview and provided a common ground for perception of improvement needs in relation to a particular future.

Group B included 18 of the 25 men who report to the Group A participants. In addition, three of the nine Production Department Superintendents participated in this group. Contacts were as follows:

Group Session (Introduction)	1 1/2 hr.
Individual Session (Interview)	1 hr.
Individual Session (Interview)	1 hr.

Groups C and D were composed of other managers and professionals as selected by the participants of Groups A and B. The 40 men were split into two groups to facilitate the group session. Contacts were as follows:

Group Session (Introduction)	1 1/2 hr.
Individual Session (Interview)	1 hr.

After the collection of need perceptions in the interview, the preliminary evaluation of these needs was undertaken by classifying them into 80 categories with common characteristics. The eight participants from Group A plus three from Group B then developed (during a two hour group session) a set of ten factors to be used in evaluating the needs as opportunities. The 80 needs were then rated (during a three hour group session) according to these factors by this eleven member management group. This group is referred to as the evaluation team in subsequent discussion.

CHAPTER IV

GENERAL ANALYSIS AND RESULTS

Improvement Needs Identified

The perceptions were gathered by interviews with the individual participants. The interview was directed only in so much as being centered on identifying needs for improvement or on problems facing the organization or the individual. The individual was permitted to present any topic, with the interviewer becoming involved only in clarification of an idea, or in bringing the interview back to its central purpose. Leading questions were used where necessary to start the interview or keep it going; typical of these questions are the following:

> What are the improvement needs of the Manufacturing Division?
>
> What are some of the problems facing the organization?
>
> What kinds of things prevent you from getting the type of results on your job that you would like?
>
> What is wrong with the organization?
>
> How do your operations, activities, etc., compare with those of your competitors?

Perceptions were recorded manually during all interviews, including those interviews or portions of interviews devoted to reviewing the prediction of the future.

Classification was carried out on a manual basis. First the interview records were reviewed and the perceptions were transferred to individual records. The records were then sorted into the major categories. These major categories were: Results, Objectives, Structure, Members, and Operational System. Perceptions related to the general overall output of the company as a whole were classified as being results-oriented needs. Those having to do with the general direction of the company and its Manufacturing Division, what it is today and where it is or should be heading, were classified under the Objective heading. Structure needs covered those relating to the structure of the organization. Perceptions concerning the people who make up the organization were classed under the Members heading. Finally, the needs identified in terms of the specific operations of the organization and the techniques by which it carries out its activities were classified as Operational System needs.

Each of these major groups was then examined individually and the perceptions within each were categorized into several major sub-groupings. These served as a second level of classification. Table 1 illustrates these first two levels of categories in outline form. A third level of classification was then developed from each sub-group. This third level grouping identifies improvement needs in terms of requirements for specific programs or activities that could be undertaken. It is the third level classification that was reviewed later by the evaluation team.

For the evaluation, these identified needs were presented by major component categories without the benefit of the major sub-groupings or without the benefit of any meaningful ordering. Subsequent to the evaluation, the needs were again reviewed and the sequence described in

Table 1 Need Classification Outline

100 Results
- 110 General
- 120 Specific

200 Objectives
- 210 Defining the Existing State of the Company and Division
- 220 Defining the Direction for the Company and Division
- 230 Planning for the Future of the Company and Division

300 Structure
- 310 Planning and Design - General
- 320 Planning and Design - Specific
- 330 Interaction

400 Members
- 410 Planning
- 420 Training
- 440 Membership Programs
- 450 Effectiveness

500 Operational System
- 510 Planning and Control
- 520 Motivation
- 530 Project Management
- 540 Quality Management
- 550 Parts Management
- 560 Operations Optimization
- 570 Processing, Facilities, and Equipment Management

this report was developed.

The results of the classification and reordering are given in the following pages, in Table 2. The same list, only with comments on the general nature of these perceptions can be found in Appendix 5.

Opportunity Evaluation Process

In order to determine the relative importance of the improvement needs identified by the manufacturing organization, it was necessary to design an evaluation technique. The purpose of this technique was to permit a subset of the original set of participants to establish a numeric value for each need that would indicate its ordinal relationship to each of the other needs. The technique so designed follows the scoring model described by Dean and Nishry (21) and is developed in Appendix 6. The steps in carrying out this scoring effort are considered in the following paragraphs of this portion of this report. The general technique was to develop a set of factors describing attributes of improvement needs. The evaluation team then rated each need in terms of these factors. These ratings, when evaluated using a set of weights for the factors, permitted the calculation of a numeric Opportunity Value for each improvement need considered.

The initial step in the process of determining values for each of the identified needs was to select these rating factors. The criteria for the selection of a factor were:

1. Is it a meaningful attribute of an improvement need that would have to be considered by management before reaching a decision on whether or not to allocate resources for the

Table 2 Perceived Improvement Needs

100 Results

110 General

111 Company growth.

120 Specific

121 Company growth through investment of treasury holdings

122 Company growth through financing of consumer credit

123 Company growth through expansion of product line within the home applicance field.

124 Company growth through diversification of products into areas other than home appliances.

200 Objectives

210 Defining the existing State of the Company and Division

211 An organization profile - a statement of organization reality.

220 Defining the Direction for the Company and Division

221 A specific statement of company objectives and philosophy.

222 A hierarchy of objectives, for each level and each organizational unit

230 Planning for the Future of the Company and Division

231 A long-range plan emphasizing the time-phased changes in objectives

300 Structure

310 Planning and Design - General

311 Review and revise the organization structure.

312 Capability and skill survey and inventory, including Quantitative Analysis capability.

313 Develop specific responsibility statements for each organizational unit.

320 Planning and Design - Specific

321 Combine functions devided into P1 and P2 divisions. Example: Maintenance, Production Control, etc.

Table 2 Perceived Improvement Needs (con't)

322 Establish a composite facilities responsibility. Example: Plant security, fire production, maintenance, etc.

323 Combine Quality Control and Quality Assurance functions.

324 Establish a Materials Management responsibility.

325 Establish a systems and procedures function.

326 Establish an Operations Research - Systems Analysis function.

327 Study of OR applications outside Manufacturing.

328 Manufacturing Research.

329 Establish an improvement function.

330 Interaction

331 Programs for improved coordination and cooperation among line organizations.

332 Programs for improved coordination and cooperation among staff organizations.

333 Programs for improved coordination and cooperation between line and staff organizations.

334 Improved relations with Marketing.

335 Improved relations with R & D.

400 Members

410 Planning

411 Manpower planning technique for predicting time-phased skills and personnel requirements.

412 A plan for organizational change due to retirements in the future.

420 Selection and Development

421 A management selection program.

422 A selection technique for specific jobs; Example: Inspectors.

423 A technique for selecting individuals to participate in training programs.

424 A management development program.

425 A program of lateral transfer for development and job enrichment.

Table 2 Perceived Improvement Needs (con't)

430 Training

431 Training programs in management techniques aimed at line management, all levels.

432 Training programs in management techniques aimed at staff personnel, all levels.

433 Training in meeting leadership for line management, all levels.

434 Training in meeting leadership for staff personnel, all levels.

435 Training in new technology for line management, all levels. Examples: OR, EDP Manufacturing Technology, etc.

436 Training in new technology for staff personnel, all levels. Examples: OR, EDP, Manufacturing Technology, etc.

440 Membership Programs

441 Analysis of employee retention problems and development of a program.

442 Analysis of College Recruitment problems and development of a program.

443 Analysis of problems of recruitment of experienced personnel and development of a program.

444 Technician program for production organizations. Technician for highly skilled and technical jobs.

445 Technician program for staff organizations. Technician to assist professions.

450 Effectiveness

451 Continuation and expansion of the Management Design activity.

452 Development of individual objectives and goals compatible with organization objectives.

453 Measurement of individual performance by comparing results to objectives.

454 Development of standards of performance for individual positions in the organization.

Table 2 Perceived Improvement Needs (con't)

500 Operational System

510 Planning and Control

511 Performance Measurement System

512 Manufacturing Improvement budget with improvement goals; evaluation of major cost areas in terms of improvement needs.

513 Study of equipment utilization and development of idle time costs.

514 Review of reports and paperwork for study of flow, duplication, effectiveness, etc.

515 Evaluation of requirements for producing either or both high grade and low grade products on a given production facility.

520 Motivation

521 Behavioral Science studies

522 New approaches to incentives

530 Project Management

531 Project management techniques for planning and scheduling. Examples: CPM, PERT.

532 Specific new product introduction or model change planning and scheduling technique.

533 Project Cost Analysis System.

540 Quality Management

541 Quality emphasis programs.

542 Quality Control studies.

543 Cost-Quality tradeoff technique and study of purchased parts rejection costs and manufactured parts rework costs, in relation to quality benefits.

550 Parts Management

551 Part Control

552 Formal Make or Buy analysis technique.

553 Value Analysis.

Table 2 Perceived Improvement Needs (con't)

560 Operations Optimization

- 561 Dynamic analysis of the manufacturing process.
- 562 Production Control System.
- 563 Scheduling purchase parts considering vendor's production schedule and in-transit inventory.
- 564 Receiving report mechanization system.
- 565 Inventory Control analysis for raw material and purchased parts.
- 566 Optimal coil slitting scheduling model.
- 567 Assembly simulation model, including line capacity and balancing.
- 568 Assembly line balancing.
- 569 Marketing-oriented studies.

570 Processing, Facilities, and Equipment Management

- 571 Specification standards for new equipment and facilities.
- 572 Safety standards.
- 573 Equipment evaluation technique - Capital investment analysis.
- 574 Maintenance Management system.
- 575 Studies in space utilization, manufacturing container design, and storage facilities.
- 576 Central Dispatching of material handling equipment.
- 577 Tooling control system.

satisfaction of the need?

2. Can relative values of the attribute be identified?

3. Can these relative values be predicted or estimated at this time?

This selection was made by an evaluation team consisting of the eight members of Group A and three members of Group B, selected by members of Group A. They are identified in Appendix 2, and in Chapter IX. The final results of this activity was the following list of factors:

a. Influence and/or Control

This factor reflects how much control the managers in the Manufacturing Division have over decisions and actions required in satisfying the specific need.

b. Value of Results - Benefits Compared to Cost

This factor is the estimate of the net result comparing both benefits and costs, of taking the necessary action to satisfy the need.

c. Physical and Monetary Resource Commitment Requirement.

This factor is an estimate of the resources that must be committed to the project or activity, if undertaken.

d. Personnel and Community Impact. (Acceptance by and Influence on the People.)

The effects of the activity on company personnel and the community are predicted by this factor.

e. Probability of Success

The likelihood that the activity will be successful and accomplish its objective is estimated under this heading.

f. Urgency of Need

The question answered by this factor is just how important is the project in terms of when it should be done, now or sometime in the future.

g. Long Range Importance and Continuity of Results

This factor is a measure of how the benefits from the activity will react to the passage of time.

h. Timeliness and Compatibility

This factor answers the questions of how important to success is the time at which the project is undertaken. Also what are problems of compatibility with other activities and how are they evaluated?

i. Personnel Resource Required

This factor considers the personnel requirements of any improvement need. The primary concern here is whether or not the skills are available within the company, and, if so, can they be assigned to the particular activity?

j. Extensiveness of the Benefit Relative to the Entire Company

The breadth of the results expected, this attribute is in answer to the question: What level or segment of the organization will be the prime benefactor of the results if this need is satisfied?

Selection of Factor Values

A decision was made to use five scale values for each factor. There were several reasons for this decision. One was that it was felt that five categories adequately covered the range of differentiable characteristics of each factor. Another reason was that having more than five distinct values increases the time and difficulty for an experienced person to rate a given improvement need. The final set of factors and their rating values are shown in Table 3.

Weighting of Factors

The factor weights were developed from preference data supplied by the evaluation team. Each of the eleven members of this team rank ordered the ten factors. This was done independently using a modified method of paired comparisons.

With this method, each individual made a choice between each pair of factors, selecting the one that was most important in determining the worth or value of an improvement need. Using the results of these comparisons, which were the counts of the number of times a particular factor was considered the most important of a comparison pair, the individual rank ordered the factors. Usually the factor with the highest score from the pairwise comparison was ranked first, but the team member was free to modify his final ranking in whatever manner he felt was appropriate. The final numeric values for the rankings assumed equal intervals between adjacent ranks. The set of rankings is shown in Table 4.

The individual rankings were then evaluated under the null hypothesis that there was a general agreement among the evaluation team as to the ordinal rankings of these factors. This was tested using the Kendall Coefficient of Concordance W as described in Siegel's Nonparametric Statistics (22). For the eleven rankings of the ten factors the value of W is 0.5358. This is tested using a chi square test with nine degrees

Table 3 Factor Rating Values

1. INFLUENCE AND /OR CONTROL

    1. No influence
    2. Limited influence and no control
    3. Limited influence and limited control
    4. Considerable control
    5. Complete control

2. VALUE OF RESULTS - BENEFITS COMPARED TO COST

    1. Low benefit to cost ratio - difficult to implement
    2. Low benefit to cost ratio - easy to implement
    3. Moderate benefit to cost ratio - moderate difficulty in implementing
    4. High benefit to cost ratio - difficult to implement
    5. High benefit to cost ratio - easy to implement

3. PHYSICAL AND MONETARY RESOURCE COMMITMENT REQUIREMENT

    1. Extensive resource requirement with delayed or slow return.
    2. Extensive resource requirement but only short delay in return
    3. Moderate resource requirement with reasonable return
    4. Minor resource requirement with delayed or slow return
    5. Minor resource requirement with rapid return

4. PERSONNEL AND COMMUNITY IMPACT
(Acceptance by and Influence on People)

    1. Unfavorable - extreme complications
    2. Complex reactions and affect
    3. Some reluctance - some adverse affects
    4. Some reluctance - but beneficial
    5. Favorable - no complication

5. PROBABILITY OF SUCCESS

    1. Under 20%
    2. 20 to 40%
    3. 40 to 60%
    4. 60 to 80%
    5. 80 to 100%

Table 3 Factor Rating Values (con't)

6. URGENCY OF NEED

    1. Can be deferred indefinitely
    2. Can be scheduled sometime in future
    3. Should be scheduled during the next 2 - 5 years
    4. Shoud be scheduled during next year
    5. Should be scheduled immediately

7. LONG-RANGE IMPORTANCE AND CONTINUITY OF RESULTS

    1. Benefits only temporary (less than 1 year)
    2. Life of benefits uncertain, but of more than temporary duration
    3. Benefits continue but with considerable maintenance costs
    4. Benefits continue, with some maintenance required
    5. Of long-range importance with continuing benefit but no more than minor maintenance required

8. TIMELINESS AND COMPATIBILITY

    1. Timing is inappropriate and conflicts with other activities underway or planned
    2. Timing is inappropriate for other reasons
    3. Timing and compatibility are no problem
    4. Timing is appropriate but compatibility with other activities is a problem
    5. Timing is appropriate and there are no compatibility problems

9. PERSONNEL RESOURCES REQUIRED

    1. Skills and manpower not available in company or outside
    2. Skills and manpower not available within company, but available outside.
    3. Skills not available within the company, but can be developed or acquired
    4. Skills available within company but manpower committed to other on-going activities
    5. Skills and manpower available

Table 3 Factor Rating Values (con't)

10. EXTENSIVENESS OF BENEFIT RELATIVE TO THE ENTIRE COMPANY

1. Benefits are limited to individuals
2. Benefits extend to groups of individuals and sub-functions
3. Benefits extend to entire departments and/or functions
4. Results would be beneficial to the entire Division or a substantial portion of it.
5. Results would be beneficial to the entire Company

Table 4 Factor Rankings

	Evaluation Team Member										
Factors	3	7	15	19	27	36	47	54	59	60	61
1	6	1	10	9	9	5	4	8	9	8	7
2	2	3	2	4	2	3	1	2	2	4	1
3	8	6	6	7	5	9	6	4	4	5	8
4	9	9	4	10	10	8	10	10	10	9	10
5	5	4	9	2	3	2	3	7	8	6	5
6	1	2	1	3	1	1	2	1	1	1	2
7	3	7	3	5	6	10	7	5	5	2	4
8	4	5	7	6	7	6	8	3	7	3	6
9	7	8	8	8	4	4	5	6	6	7	9
10	10	10	5	1	8	7	9	9	3	10	3

of freedom. The value of χ^2 is 53.04 for the set of rankings while χ^2 for .001 significance is 27.88. Therefore it is assumed that the observed value of W is different from zero which implies a significant level of general agreement among the rankings.

Further analysis of the rankings is possible by determining the degree correlation between individual rankings in an effort to select the ranking most representative of the group. The rankings were evaluated by determining the correlation between individual sets of ranks. The specific technique was used to calculate the Spearman Rank Correlation Coefficient, ρ. Table 5 gives the correlation matrix for this analysis. The specific matrix cell at row i and column j, cell ij, is the value of ρ_{ij} resulting from the comparison of ranking i with ranking j. Values of ρ above 0.564 are considered to be significant at a 5% error level, and are identified with an asterisk (23). (Because $\rho_{ij} = \rho_{ji}$ and ρ_{ii} = 1.0 only that portion of the matrix above the main diagonal is unique.)

As this technique did not indicate any particular pattern of correlation that was useful in determining a ranking that was most typical of the group, further analysis was carried out using Kemeny and Snell (24). The algorithm so developed permits the designation of the specific ranking out of a group of preference rankings, that is closest to the theoretical mean ranking. The result of this analysis is shown in Table 6. In that Table, the last column is the factor weight, developed by the method of Appendix 6. Because of the fact that information provided by preference rankings is ordinal only and provides no information concerning the relative size of the intervals between ranks, it was necessary

Table 5 Rank Correlation Matrix

	RANKING										
	3	7	15	19	27	36	47	54	59	60	61
3	1.000	0.697*	0.418	0.285	0.673*	0.491	0.685*	0.806*	0.406	0.879*	0.624*
7		1.000	-0.079	0.42	0.430	0.600*	0.794*	0.527	0.103	0.479	0.358
15			1.000	0.297	0.345	-0.030	0.079	0.467	0.673*	0.479	0.552
19				1.000	0.515	0.358	0.285	0.273	0.624*	0.236	0.818*
27					1.000	0.661*	0.806*	0.758*	0.661*	0.636*	0.552
36						1.000	0.770*	0.358	0.224	0.188	0.394
47							1.000	0.588*	0.406	0.442	0.503
54								1.000	0.673*	0.891*	0.527
59									1.000	0.479	0.745*
60										1.000	0.467
61											1.000

Table 6 Consensus Factor Ranking & Weighting

	Factor	Mean Ranking r_j	Factor Weight (w_j)
1	Influence and/or Control	8.5	9.09
2	Value of Results - Benefits Compared to Cost	2	32.73
3	Physical and Monetary Resource Commitment Requirement	6	18.18
4	Personnel and Community Impact	10	3.64
5	Probability of Success	3.5	27.27
6	Urgency of Need	1	36.36
7	Long-Range Importance and Continuity of Results	3.5	27.27
8	Timeliness and Compatibility	5	21.82
9	Personnel Resources Required	7	14.55
10	Extensiveness of Benefit Relative to the Entire Company	8.5	9.09

to make the assumption that these intervals were uniform and equal. As a result, each ranking unit has a specific value as determined by the design parameter of the scoring model. The weight applied to a specific ranking is then a multiple of this ranking unit. This relationship is evident in Table 6.

Rating of Needs

A listing of the eighty identified needs was prepared in enough copies for each member of the evaluation team to have one set for each factor. The rating was performed by having each member rank all needs for one factor at a time. To do this he familiarized himself with the rating values for a particular factor and then filled in a blank for each of one of the eighty needs with the number of the rating value he felt was most appropriate.

The result of this activity can be considered as a m x n x q matrix designated Y' with individual cell values of y'_{ijk}. In this case, $i \{i:i = 1, 2, 3, \ldots, m\}$, is the index of the identified improvement need and has a maximum value, m, of 80. Also, j, $\{j:j = 1,2,3,\ldots,n\}$, is the index of the rating factor which in this study has the maximum value, n, of 10. The remaining index, k, $\{k:k = 1,2,3,\ldots,q\}$, indicates the particular member of the evaluation team and has a maximum value, q, of 11. The individual cell, y'_{ijk}, is then the k^{th} individual's rating of the i^{th} need for the j^{th} factor. The value of a particular cell could take on the values of zero through five according to the factor values assigned by the individual.

The final composite rating value matrix is an m x n matrix Y whose cell values, y_{ij} are determined as follows:

$$y_{ij} = [\sum_{k=1}^{k=q} y'_{ijk}/q + 0.5]$$

where

[x] indicates the greatest integer value $\leq$ x. The final rating value matrix, Y, is shown in Table 7.

Evaluation Results

The Opportunity Value of a specific improvement need i, $\{i:i = 1,2,3,\ldots,m\}$ was defined as the total score, e_i, $\{e_i:i = 1,2,3,\ldots,m\}$ when the total score is:

$$e_i = \sum_{j=1}^{j=n} w_j \, y_{ij} \, ,$$

where n = 10, the number of factors

w_j = the factor weight, j = 1,2,3,..., n

The resulting set of Opportunity Values is shown in Table 8. The relative rank of the Opportunity Value is also given for the eighty needs identified. (Rank 1 has the highest Opportunity Value; Rank 80, the lowest.)

Calculation of Individual Results

The needs identified by individuals were recorded and provide the basis for Table 9 which indicates which needs a particular individual perceived. They range from one perception to twenty-six perceptions - out of a maximum possible of eighty. Tables 10 and 11 give the number of perceptions per participant and the number of times a particular need was perceived, respectively. The number of times a particular need was

Table 7 Need Rating Values

	FACTORS									
NEEDS	1	2	3	4	5	6	7	8	9	10
111	3	4	1	5	4	5	4	4	4	5
121	2	3	2	4	3	4	4	3	5	5
122	1	2	2	3	2	2	2	2	3	5
123	2	4	1	4	4	4	3	4	4	5
124	2	2	1	3	2	3	3	2	3	5
211	4	3	4	5	4	3	4	4	4	5
221	3	4	4	5	4	4	5	4	5	5
222	4	3	4	4	4	4	4	4	5	4
231	4	4	4	5	4	3	4	4	5	4
311	5	2	4	3	4	3	4	4	4	4
312	4	3	3	4	3	3	3	3	4	4
313	5	3	4	4	4	4	4	4	5	4
321	5	2	4	3	2	2	3	2	4	3
322	4	1	4	2	3	2	3	2	4	4
323	5	3	4	3	3	2	4	2	4	4
324	4	3	3	4	3	2	4	3	4	4
325	4	3	3	4	3	3	4	3	4	4
326	4	3	3	3	3	3	3	3	3	4
327	2	3	3	3	2	2	3	2	3	5
328	4	3	3	4	3	3	3	3	4	4
329	4	4	4	4	4	4	4	4	4	4
331	5	4	4	4	4	4	4	4	5	4
332	5	4	4	4	4	4	4	4	4	4
333	5	4	4	4	4	4	4	4	5	4
334	3	3	4	4	4	4	4	5	5	5
335	3	4	4	4	3	4	4	5	4	5
411	5	3	4	5	4	4	4	4	4	4

Table 7 Need Rating Values (Cont.)

NEEDS	FACTORS 1	2	3	4	5	6	7	8	9	10
412	4	4	4	5	4	4	4	4	5	5
421	4	4	4	4	4	4	4	4	4	4
422	4	4	4	4	4	3	4	4	4	3
423	5	3	4	4	4	3	4	4	5	3
424	4	3	4	5	4	4	4	4	4	5
425	5	3	4	4	3	3	3	3	4	3
431	4	3	3	4	4	4	4	4	4	4
432	5	4	3	4	4	4	4	4	4	4
433	4	3	3	4	4	4	4	3	4	3
434	5	3	4	4	4	3	4	4	4	3
435	5	3	3	4	3	3	3	3	3	3
436	5	4	3	4	4	4	3	4	3	3
441	4	3	4	4	3	4	4	5	4	4
442	3	3	4	5	3	4	4	5	5	4
443	3	3	4	4	3	4	4	5	4	4
444	4	3	3	4	4	3	4	4	4	3
445	4	3	3	4	4	4	4	4	4	3
451	5	4	4	4	4	4	4	4	5	4
452	5	3	4	4	4	4	4	4	4	3
453	5	3	4	4	4	4	4	4	4	3
454	5	3	4	4	4	4	4	4	4	3
511	4	3	3	4	4	4	3	4	4	4
512	4	4	4	4	4	4	3	4	4	4
513	5	4	3	4	4	4	4	4	4	4
514	5	3	4	4	4	4	4	4	4	4
515	5	3	3	3	3	2	2	3	3	3
521	5	3	4	4	3	3	3	3	4	3

Table 7 Need Rating Values (Cont.)

NEEDS	FACTORS 1	2	3	4	5	6	7	8	9	10
522	4	3	3	4	3	4	3	4	3	4
531	5	3	4	4	4	4	3	4	4	4
532	4	4	3	4	4	4	3	4	4	4
533	4	4	3	4	4	4	4	4	4	4
541	5	3	3	4	3	4	3	4	4	4
542	5	3	3	4	4	4	3	4	4	4
543	5	3	3	4	4	3	4	4	4	4
551	4	3	3	4	4	4	4	4	5	4
552	5	3	4	4	4	4	4	4	5	4
553	4	4	3	3	3	3	3	3	3	5
561	4	4	2	4	4	4	3	3	3	4
562	5	4	3	4	4	4	3	4	4	4
563	5	3	4	4	4	4	4	4	4	4
564	4	3	4	5	5	4	4	4	4	3
565	5	3	4	4	5	4	4	4	4	3
566	5	3	4	4	4	4	4	4	4	2
567	5	4	3	4	3	3	3	4	4	3
568	5	3	4	4	4	4	3	4	4	3
569	3	3	3	3	3	4	3	3	4	5
571	5	3	3	4	4	4	4	4	4	4
572	4	4	4	4	5	5	4	5	5	4
573	4	3	3	4	4	4	4	4	4	4
574	4	4	3	4	4	4	3	4	4	4
575	5	3	3	5	4	4	4	4	5	4
576	5	3	3	4	3	3	4	3	4	3
577	5	3	4	4	4	4	4	4	4	3

Table 8 Opportunity Values and Ranking

	Opportunity Value	Opportunity Value Ranks
100 Results		
110 General		
111 Company growth.	785.5	18
120 Specific		
121 Company growth through investment of treasury holdings.	687.3	61
122 Company growth through financing of consumer credit.	432.4	80
123 Company growth through expansion of product line within the home applicance field.	709.1	55
124 Company growth through diversification of products into areas other than home appliances.	490.9	79
200 Objectives		
210 Defining the Existing State of the Company and Division		
211 An organization profile - a statement of organization reality.	743.6	46
220 Defining the Direction for the Company and Division		
221 A specific statement of company objectives and philosophy.	845.5	2
222 A hierarchy of objectives, for each level and each organizational unit.	781.8	20
230 Planning for the Future of the Company and Division		
231 A long-range plan emphasizing the time-phased changes in objectives.	781.8	20
300 Structure		
310 Planning and Design - General		
311 Review and revise the organization structure.	703.6	57
312 Capability and skill survey and inventory, including Quantitative Analysis capability.	636.4	69.5
313 Develop specific responsibility statements for each organizational unit.	790.9	14.5

Table 8 Opportunity Values and Ranking (Cont.)

	Opportunity Value	Opportunity Value Ranks
320 Planning and Design - Specific		
321 Combine functions divided into P1 and P2 divisions. Example: Maintenance, Production Control, etc.	532.7	76
322 Establish a composite facilities responsibility. Example: Plant security, fire production, maintenance, etc.	523.6	77.5
323 Combine Quality Control and Quality Assurance functions.	629.1	71
324 Establish a Materials Management responsibility.	627.3	72
325 Establish a systems and procedures function.	636.6	64.5
326 Establish an Operations Research - Systems Analysis function.	618.2	74
327 Study of OR applications outside Manufacturing.	523.6	77.5
328 Manufacturing Research.	636.4	69.5
329 Establish an improvement function.	800.0	9.5
330 Interaction		
331 Programs for improved coordination and cooperation among line organizations.	823.6	5
332 Programs for improved coordination and cooperation among staff organizations.	809.1	7
333 Programs for improved coordination and cooperation between line and staff organizations.	823.6	5
334 Improved relations with Marketing.	803.6	8
335 Improved relations with R & D.	794.5	11.5
400 Members		
410 Planning		
411 Manpower planning technique for predicting time-phased skills and personnel requirements.	780.0	22.5
412 A plan for organizational change due to retirements in the future.	827.3	3
420 Selection and Development		
421 A management selection program.	800.0	9.5
422 A selection technique for specific jobs; example: Inspectors.	754.5	39
423 A technique for selecting individuals to participate in training programs.	745.5	45

Table 8 Opportunity Values and Ranking (Cont.)

		Opportunity Value	Opportunity Value Ranks
	424 A management development program.	780.0	22.5
	425 A program of lateral transfer for development and job enrichment.	654.5	67.5
430	Training		
	431 Training programs in management techniques aimed at line management, all levels.	749.1	43
	432 Training programs in management techniques aimed at staff personnel, all levels.	790.9	14.5
	433 Training in meeting leadership for line management, all levels.	718.2	54
	434 Training in meeting leadership for staff personnel, all levels.	730.9	50.5
	435 Training in new technology for line management, all levels. Examples: OR, EDP, Manufacturing Technology, etc.	621.8	73
	436 Training in new technology for staff personnel, all levels. Examples: OR, EDP, Manufacturing Technology, etc.	740.0	48
440	Membership Programs		
	441 Analysis of employee retention problems and development of a program.	761.8	35
	442 Analysis of College Recruitment problems and development of a program.	770.9	28
	443 Analysis of problems of recruitment of experienced personnel and development of a program.	752.7	41
	444 Technician program for production organizations. Technician for highly skilled and technical jobs.	703.6	57
	445 Technician program for staff organizations. Technician to assist professions.	740.0	48
450	Effectiveness		
	451 Continuation and expansion of the Management Design activity.	823.6	5
	452 Development of individual objectives and goals compatible with organization objectives.	767.3	30.5
	453 Measurement of individual performance by comparing results to objectives.	767.3	30.5
	454 Development of standards of performance for individual positions in the organization.	767.3	30.5

Table 8 Opportunity Values and Ranking (Cont.)

500 Operational System	Opportunity Value	Opportunity Value Ranks
510 Planning and Control		
511 Performance Measurement system	721.8	50.5
512 Manufacturing Improvement budget with improvement goals; evaluation of major cost areas in terms of improvement needs.	772.7	27
513 Study of equipment utilization and development of idle time costs.	790.9	14.5
514 Review of reports and paperwork for study of flow, duplication, effectiveness, etc.	776.4	25
515 Evaluation of requirements for producing either or both high grade and low grade products on a given production facility.	554.5	75
520 Motivation		
521 Behavioral Science studies	654.5	67.5
522 New approaches to incentives	680.0	62
530 Project Management		
531 Project management techniques for planning and scheduling. Examples: CPM, PERT.	749.1	43
532 Specific new product introduction or model change planning and scheduling technique.	754.5	39
533 Project Cost Analysis System.	781.8	20
540 Quality Management		
541 Quality emphasis programs.	703.6	57
542 Quality Control studies.	730.9	50.5
543 Cost-Quality tradeoff technique and study of purchased parts rejection costs and manufactured parts rework costs, in relation to quality benefits.	721.8	52.5
550 Parts Management		
551 Part Control.	763.6	33.5
552 Formal Make or Buy analysis technique.	790.9	14.5
553 Value Analysis.	660.0	66
560 Operations Optimization		
561 Dynamic analysis of the manufacturing process.	700.0	59
562 Production Control System.	763.6	33.5
563 Scheduling purchase parts considering vendor's production schedule and in-transit inventory.	776.4	25

Table 8 Opportunity Values and Ranking (Cont.)

		Opportunity Value	Opportunity Value Ranks
564	Receiving report mechanization system.	789.1	17
565	Inventory Control analysis for raw material and purchased parts.	794.5	11.5
566	Optimal coil slitting scheduling model.	758.2	36.5
567	Assembly simulation model, including line capacity and balancing.	690.9	60
568	Assembly line balancing.	740.0	48
569	Marketing-oriented studies.	669.1	63
570	Processing, Facilities, and Equipment Management		
571	Specification standards for new equipment and facilities.	758.2	36.5
572	Safety standards.	900.0	1
573	Equipment evaluation technique - Capital investment analysis.	749.1	43
574	Maintenance Management system.	754.5	39
575	Studies in space utilization, manufacturing container design, and storage facilities.	776.4	25
576	Central dispatching of material handling equipment.	663.6	64.5
577	Tooling control system.	767.3	30.5

TABLE 9 Needs Perceived by Participants

	INDEX																									
Participant	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	Perceived Needs																									
1	221,	324,	424,	431,	451,	532,	542,																			
2	311,	326,	332,	431,	444,	511,	522,	531,	562,	572,	573,	574,														
3	231,	311,	326,	329,	411,	412,	424,	431,	432,	435,	436,	441,	451,	532,	542,	551,	553,	571,	573,	574						
4	311,	321,	324,	326,	425,	431,	432,	435,	562,																	
5	123,	311,	323,	334,	335,	411,	422,	435,	451,	541,	542,	543,														
6	412,	521,	552,	569,																						
7	231,	311,	411,	412,	431,	451,	511,	532,	561,	562,																
8	111,	121,	124,	221,	222,	311,	332,	412,	432,	433,	434,	435,	436,	441,	445,	451,	453,	513,	514,	521,	522,	533,	541,	553		
9	123,	332,	333,	335,	431,	521,	531,	561,																		
10	231,																									
11	231,	326,	424,	436,	451,	521,	532,	551,	561,	562,	569,															
12	221,	231,	328,	432,	511,	521,	571,	572																		
13	321,	326,	424,	425,	431,	435,	451,	522,	532,	562,	569,	571,	573,	574,												
14	122,	123,	311,	333,	412,	421,	424,	425,	432,	451,	532,															
15	111,	123,	221,	313,	423,	424,	435,	436,	441,	442,	443,	445,	514,	521,	532,	543,	565,	573,	574,							
16	435,	436,	454,	522,	531,	571,	572,	573,	574,	577,																
17	221,	425,	441,	522,	541,	542,																				
18	221,	324,	326,	335,	435,	511,	511,	551,	563,	565,	569,															
19	111,	211,	221,	222,	231,	311,	329,	411,	412,	424,	425,	531,	432,	536,	441,	451,	511,	515,	521,	532						
20	123,	313,	321,	324,	326,	451,	562,	569,	571,	573,																
21	123,	124,	231,	311,	326,	424,	431,	435,	436,	441,	522,	562,	569,													
22	335,	411,	424,	434,	435,	452,	553,																			
23	411,	435,	541,	561,	569,																					
24	329,	332,	335,	432,	436,	451,	531,	571,																		
25	123,	313,	325,	332,	434,	436,	445,	451,	452,	514,	531,	532,	533,	542,	551,	553,										
26	231,	326,	434,	441,	445,	573,																				
27	231,	326,	328,	332,	335,	411,	424,	432,	435,	436,	445,	531,	532,	561,	562,	573,										
28	313,	326,	329,	412,	435,	436,	445,	522,	542,	553,	562,	569,														
29	321,	326,	329,	331,	424,	425,	543,	571,																		
30	111,	222,	311,	313,	514,	522,	531,	542,																		
31	123,	124,	221,	321,	411,	412,	432,	435,	436,	441,	445,	532,	551,	561,	562,	568,	574,									
32	313,	411,	412,	424,	425,	432,	436,	441,	522,	533,	573,															
33	311,	326,	332,	335,	451,	512,	551,																			
34	311,	326,	328,	411,	436,	442,	445,	512,	521,																	
35	124,	231,	412,	451,	543,	562																				

TABLE 9 Needs Perceived by Participants (Cont.)

Participant	INDEX 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 — Perceived Needs
36	111, 123, 211, 221, 411, 424, 432, 435, 453, 521, 532, 541, 542, 543
37	221, 332, 335, 421, 424, 425, 513, 514, 522, 531, 553,
38	326, 412, 424, 425, 431, 436, 442, 452, 521, 522, 541, 561, 562,
39	122, 124, 424, 425, 441, 532, 561, 562, 569,
40	411, 435, 452, 562, 574,
41	221, 222, 231, 311, 326, 329, 332, 334, 335, 411, 424, 451, 511, 522, 532, 562, 567, 569, 573,
42	231, 412, 424, 452, 514, 521,
43	311, 329, 332, 411, 511,
44	221, 231, 311, 326, 423, 424, 425, 432, 436, 454, 511, 522, 569,
45	222, 311, 326, 329, 332, 335, 411, 412, 424, 431, 435, 436, 442, 443, 445, 511, 512, 513, 514, 522, 553, 562, 566, 568,
46	221, 311, 326, 327, 436, 441, 442, 445, 451, 511, 512, 521, 522, 532, 553, 561, 562, 573,
47	111, 124, 231, 326, 328, 332, 411, 431, 435, 436, 442, 531, 532, 552, 574,
48	221, 222, 231, 412, 424, 425, 432, 435, 441, 451, 513, 571,
49	329, 522, 564, 574, 575, 576,,
50	313, 329, 335, 412, 436, 445, 531, 532, 541, 552, 569,
51	111, 121, 221, 231, 322, 326, 332, 411, 432, 445, 511, 514, 533, 569, 571, 573, 574,
52	422, 521, 541, 543, 562, 575, 577,
53	332, 436, 441, 451, 512, 533,
54	311, 326, 411, 412, 424, 431, 432, 435, 436, 444, 451, 542, 562, 565,
55	323, 335, 432, 451, 543,
56	231, 441,
57	123, 231, 331, 431, 541, 543,
58	329, 432, 435, 445, 573,
59	221, 231, 311, 326, 329, 333, 335, 411, 424, 436, 443, 445, 511, 512, 522, 531, 532, 533, 543, 552,553, 561, 562, 565, 567, 574,
60	123, 313, 324, 326, 335, 411, 552, 553, 563, 565, 569,
61	221, 231, 326, 328, 334, 335, 411, 441, 512, 531, 532, 552, 569, 573,
62	331, 333, 451, 574,
63	111, 123, 221, 326, 411, 412, 421, 424, 425, 431, 432, 434, 435, 436, 441, 442, 443, 451, 574, 577,
64	221, 332, 412, 434, 435, 436, 442, 451, 453, 511, 541, 543, 553, 567,
65	326, 435, 511, 532, 542, 562,
66	432, 445, 451, 551, 573,
67	231, 335, 431, 541, 542, 551, 553, 564, 574,
68	335, 532, 561, 562, 571, 577,
69	412, 431, 435, 436, 441, 451, 574, 577,

Table 10 Individual Perception Count

Participant	No. of Needs Perceived	Participant	No. of Needs Perceived
1	7	36	15
2	12	37	12
3	20	38	14
4	9	39	9
5	12	40	5
6	4	41	19
7	10	42	6
8	24	43	5
9	8	44	13
10	1	45	24
11	11	46	18
12	8	47	15
13	14	48	12
14	11	49	6
15	19	50	11
16	10	51	17
17	6	52	7
18	10	53	6
19	20	54	14
20	10	55	5
21	13	56	2
22	7	57	6
23	5	58	5
24	8	59	26
25	16	60	11
26	6	61	14
27	16	62	4
28	12	63	20
29	8	64	14
30	8	65	6
31	17	66	5
32	11	67	9
33	7	68	6
34	9	69	8
35	6		

Table 11 Perceptions of Each Need

Need	No. of Participants Who Perceived Need	Need	No. of Participants Who Perceived Need	Need	No. of Participants Who Perceived Need	Need	No. of Participants Who Perceived Need
111	8	329	12	442	8	543	10
121	2	331	3	443	4	551	8
122	2	332	15	444	2	552	6
123	12	333	4	445	15	553	12
124	6	334	3	451	25	561	11
211	2	335	17	452	5	562	22
221	19	411	22	453	3	563	2
222	6	412	19	454	3	564	2
231	21	421	3	511	14	565	5
311	19	422	2	512	7	566	1
312	0	423	2	513	4	567	3
313	8	424	24	514	8	568	2
321	5	425	13	515	1	569	15
322	1	431	18	521	13	571	10
323	2	432	19	522	17	572	3
324	5	433	1	531	12	573	15
325	1	434	6	532	21	574	15
326	27	435	25	533	6	575	2
327	1	436	26	541	11	576	1
328	5	441	17	542	12	577	5

perceived ranged from 0 (for a control need introduced by the investigator) to a high of twenty-seven for need No. 326, (identifying the need for an Operations Research activity.)

Using this individual information it is possible to define and calculate and Individual Perception Index (IPI) score, d_k, $\{d_k : k = 1,2,3,\ldots,p\}$ where p = 69, the number of participants. The score, d_k, would be a function of the needs identified by an individual and the Opportunity Value assigned to these needs as a result of the group evaluation. The relationship is:

$$d = (0.01)\ N\ e$$

where

N = p x m Perception Matrix where the individual cell item $n_{ki} = 1$ if number k perceives need i, and 0 if he does not.

e = Opportunity Value Vector with elements e_i, $\{e_i : i = 1,2,3,\ldots,80\}$, equal to the Opportunity Value assigned by the model (see Table 12).

d = Individual Perception Index Vector with element, d_k, $\{d_k : k = 1,2,3,\ldots,69\}$, equal to the IPI of a participant k.

The Individual Perception Index scores, the results of this calculation are given in Table 13. They range from a low of 7.82 to a high of 194.96 out of a maximum possible score of 575.70. The relative ranks for the individual are also calculated and shown in the Table.

Table 12 Perception Matrix

PARTICIPANTS	NEEDS																				
	111	121	122	123	124	211	221	.	.	.	.	.	.	.	571	572	573	574	575	576	577
1	0	0	0	0	0	0	1	.	.	.	.	.	.	.	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	.	.	.	.	.	.	.	0	1	1	1	0	0	0
3	0	0	0	0	0	0	0	.	.	.	.	.	.	.	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	.	.	.	.	.	.	.	0	0	0	0	0	0	0
5	0	0	0	1	0	0	0	.	.	.	.	.	.	.	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	.	.	.	.	.	.	.	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	.	.	.	.	.	.	.	0	0	0	0	0	0	0
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
63	1	0	0	1	0	0	1	.	.	.	.	.	.	.	0	0	0	1	0	0	1
64	0	0	0	0	0	0	1	.	.	.	.	.	.	.	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	.	.	.	.	.	.	.	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	.	.	.	.	.	.	.	0	0	1	0	0	0	0
67	0	0	0	0	0	0	0	.	.	.	.	.	.	.	0	0	0	1	0	0	0
68	0	0	0	0	0	0	0	.	.	.	.	.	.	.	1	0	0	0	0	0	1
69	0	0	0	0	0	0	0	.	.	.	.	.	.	.	0	0	0	1	0	0	1

Table 13 Individual Perception Index

Participant	Index	Ranking	Participant	Index	Ranking
1	53.11	47	36	111.38	14
2	89.02	25	37	91.07	23
3	149.49	6	38	101.40	19
4	60.62	41	39	60.11	43
5	87.76	26	40	36.87	64
6	29.42	67	41	143.51	7
7	76.05	33	42	45,87	52
8	176.73	3	43	38.14	61
9	59.89	45	44	94.98	21
10	7.82	69	45	179.33	2
11	80.49	31	46	129.83	9
12	60.89	40	47	108.33	15
13	99.09	20	48	92.18	22
14	81.03	30	49	44.64	55
15	142.49	8	50	83.60	28
16	74.87	34	51	125.73	10
17	43.76	58	52	51.42	49
18	72.33	35	53	46.89	51
19	150.34	5	54	104.27	18
20	70.42	36	55	37.60	62
21	90.69	24	56	15.44	68
22	51.34	50	57	44.89	54
23	34.74	65	58	37.02	63
24	62.65	39	59	194.96	1
25	119.91	12	60	80.11	32
26	43.82	57	61	105.07	16
27	118.09	13	62	32.25	66
28	86.42	27	63	150.64	4
29	56.89	46	64	104.34	17
30	59.98	44	65	42.11	59
31	123.16	11	66	38.67	60
32	83.36	29	67	67.27	37
33	52.85	48	68	45.38	53
34	64.16	38	69	60.45	42
35	44.09	56			

CHAPTER V

ANALYSIS OF PERCEPTION RESULTS

In the previous chapters the concepts underlying the study have been discussed and the initial results described. The first analysis of these results will be considered in this chapter along with the specific conclusions resulting from this analysis. The first inquiry was directed toward the question of which of the characteristics determined for individual participants were significant in relationship to that participant's perception of improvement needs. The index used to measure the participant's perceptions was the Individual Perception Index (IPI) developed at the end of the previous chapter. The IPI was a function of the number of perceived needs accorded an individual and the opportunity value assigned each of those needs by the evaluation team. This index had a range of from 7.82 to 194.96. Its mean value was 80.0 and it had a distribution of values as shown in the histogram found in Figure 7. This index was considered the overall performance measure for individuals participating in the study, a high value equivalent to high performance and a low value to low performance. The consideration of what the perception actually was, was not considered at this time; that will be discussed in later chapters.

To evaluate those attributes of the participant that might have some relation to the IPI, a series of characteristics was developed and scores for each individual determined. The source of these characteristics

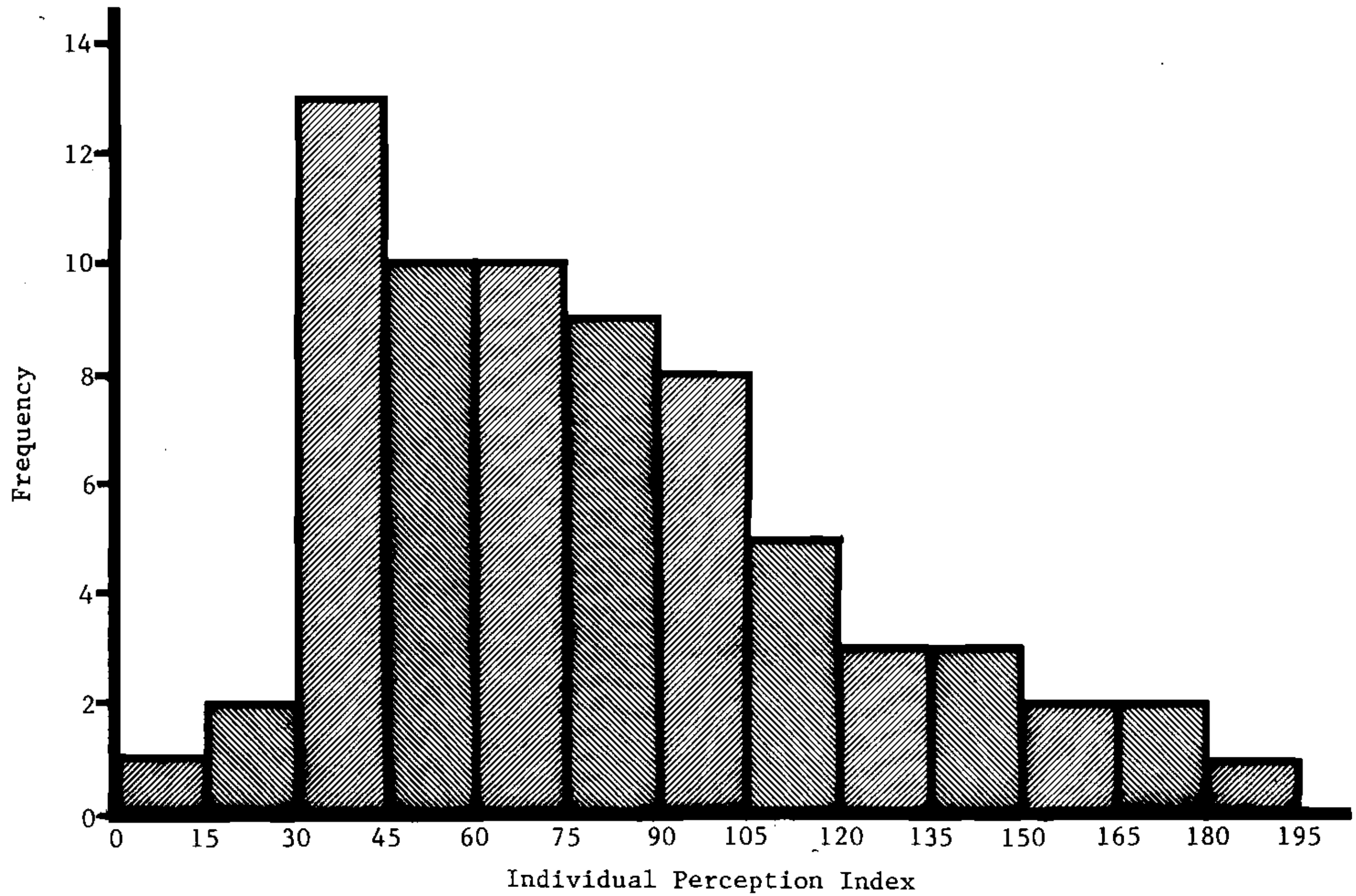


Figure 7 IPI Histogram

was primarily the information received from the individual by questionnaire. The criterion used in determining these characteristics was their relative ease of gathering. That is, they were all single measurements, requiring a minimum of effort on the part of the individual to supply the data. Particular effort was given to their selection to avoid any connotation on the part of the participant that might make him feel he was taking a test or was being graded on how well he filled in the questionnaire. A copy of the questionnaire is found in Appendix 3.

The importance of each of these characteristics was tested by determining the correlation coefficient, r, between the characteristic and the IPI. r was considered significantly different from zero if the absolute value of r exceeded 0.25. This was equivalent to a 5% level of significance using a two tailed "Student's t" test, a two-tailed test being used because identification of highly correlated variables with either positive or negative r would be of value in the analysis. The following section discusses each characteristic and gives r plus any other pertinent data.

Individual Characteristics

Years of Formal Education - Char. No. 1

The Characteristic was assessed from the responses to the education and training section of the questionnaire. The mean of this variable was 14.42, which indicated 2 1/2 years of formal education beyond high school was typical of the group. The correlation between this variable and the IPI was .24 which was not significantly different from zero at the 5% level of significance.

Years with the company - Char. No. 2

In response to a question of how long the individual had been an employee of the company, another variable was developed. It had a mean of 17.45 years and a range from three years to forty years with the company. Its correlation coefficient, r, was -.09, which was not significant.

Age - Char. No. 3

The age of participant had a mean value of 42.97 years. Its value of r was 0.10, and was not significant.

Age started at Company - Characteristic No. 4

This characteristic is the difference between the age of the participant and the years he had been with the company. It had a mean of 25.38 years and a range from 18 to 47 years of age at the time of joining the company. Its correlation with the IPI was .22, which was not significant.

Years of other Experience - Char. No. 5

The variable was also calculated. It was determined from the difference between the equivalent age at the time of completing formal education (Char. No. 1 plus 6 years) and the age that the participant started with the company (Char. No. 3 minus Char. No. 2). The resulting variable is equivalent to:

Char. No. 5 = (Char. No. 3 - (Char. No. 1 + 6.0) - Char. No. 2)

The variable is all inclusive and would cover any experience: military, industrial, etc., that had consumed the years calculated in this manner. The resulting variable had a mean of 4.94 years, an r of .12, and therefore was not significant.

Managerial Level - Char. No. 6

The organization chart and title of individuals were used to assign them to one of seven managerial levels. The highest level, seven, was the vice presidential level and the lowest level, one, was that of engineer or foreman. The mean level for participants was 3.22. The correlation coefficient for this variable was 0.52 which was significantly different from zero at the 5% level of significance, indicating higher level managers tended to have a larger IPI, reflecting greater need perception.

Achievement Index - Char. No. 7

The Achievement Index (AI) was developed to measure the relative progress of the individual in the organization. The index is a general one and compares an individual to a hypothetical rate of achievement equivalent to a promotion for every five years of experience. Under this evaluation achievement is equated with being even or ahead of this hypothetical scale, underachievement would result from being behind the scale. The scale expects a promotion from managerial level 1 to level 2 at age 25 and to level 3 at age 30, etc., through to promotion to level 8 at 55 years of age. The AI for an individual k was calculated in the following manner:

$$AI_k = (\text{managerial level})_k - 0.2\ (\text{age})_k + 4.0$$

when

$$k = \text{participant index}, \{k : k = 1,2,3,\ldots,69\}$$

In terms of this characteristic discussed, this equation becomes:

$$AI = (\text{Char. No. } 6) - 0.2\ (\text{Char. No. } 3) + 4.0$$

The mean value for the AI is -1.39 and ranges from +0.8 to -5.4. It is equivalent in numeric value to the number of levels the individual is ahead (positive) or behind (negative) for his age. If it is divided by 0.2, the result is equivalent to the number of years he is ahead or behind. The index is different from a similar index developed by Blake and Mouton in _The Managerial Grid_ in that it is a linear relationship and as such is directly comparable to years or levels (25). Figure 8 illustrates the AI in relation to its component characteristics. The correlation coefficient of r = .35 indicates that this variable is significantly correlated with the Individual Perception Index.

Business Contacts - Char. No. 8

This characteristic resulted from rating the participant's response to question 1 of the questionnaire. The rating scale applied ranged from 0 for no outside contacts to 5 for contacts that were extensive and on a repetitive, continuing basis. The mean value was 2.03 and the variable was significantly correlated with the IPI (r = .43).

Memberships - Char. No. 9

The membership characteristic was also developed by rating the participant's response to a question on the questionnaire, this time No. 2. The rating ranged from 0 for no memberships to 5 for extensive memberships in work or job related organizations. The mean value was 2.03 and had a value of r of 0.48, which was significant.

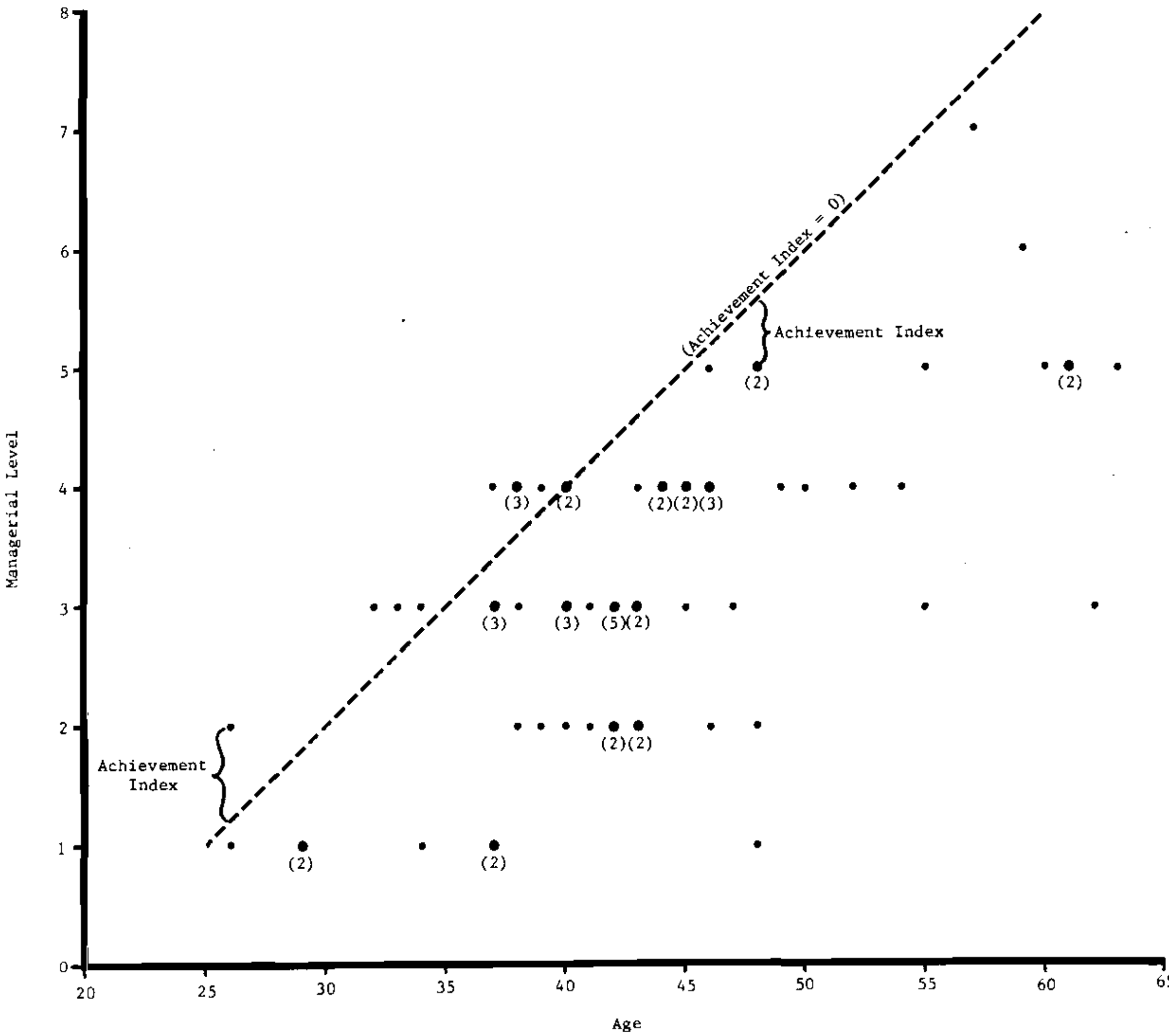


Figure 8 Achievement Index

Reading - Char. No. 10

This variable was handled in the same manner as the two previous characteristics. The rating applied to question 3 ranged from 0 for no job-oriented reading to 5 for reading that was both extensive and job-oriented. This characteristic had an average rating of 2.29 and was significantly correlated, having an r of 0.33.

Social Indegree - Char. No. 11

This characteristic was the result of analysis of the response to question 4 which asked for social contacts within the organization. The analysis technique is described in Appendix 8. The social indegree was the number of times an individual was identified by another participant as being a social contact. The mean value was 0.94 and correlation coefficient was 0.32, indicating that the variable was significantly correlated with the IPI.

Social Symmetry - Char. No. 12

This variable is the number of reciprocal identifications of social contact. If man A identifies man B and man B identifies man A, this is termed a symmetrical relationship. There were very few of these, resulting in a mean value of 0.43 and a nonsignificant correlation coefficient of 0.17.

Discussion Indegree - Char. No. 13

This was an indegree measurement made on responses to question 5, which asked for those persons the participant discussed his work or problems most frequently with. The mean value was 2.14 and the r value was 0.48, which was significant. This could be taken to indicate that individuals with higher IPI values might have greater exposure to the problems of the organization and, therefore, be in a better position to identify needs.

Discussion Symmetry - Char. No. 14

This characteristic was the number of symmetrical discussion relationships and had a mean of 0.54. It was not significant with a correlation coefficient of 0.23.

Advice Indegree - Char. No. 15

The responses to question 6 identified the individuals sought for advice or information, the indegree number serves as this characteristic. It had a mean of 2.62 and an r of 0.42, indicating significance.

Advice Symmetry - Char. No. 16

This was the number of symmetrical advice relationships and had a mean of 0.42 and an r of 0.18, not significant.

Projects Indegree - Char. No. 17

This variable was in response to the question (No. 7) asking the participant to identify the individual he worked with on joint assignments or projects. The mean indegree was 2.28 and the variable was not significantly correlated with the IPI ($r = .18$).

Project Symmetry - Char. No. 18

This characteristic was the result of reciprocal identifications and had a mean of 0.74 of such contacts. It had an r of 0.25 and was therefore considered significant.

Choice Indegree - Char. No. 19

This variable was the sum of Char. Nos. 13, 15, and 17. It was identified as Choice Indegree because the participant would be able to exercise considerable choice in selected particular individuals. This sum averaged 5.68 and was significantly correlated, having a value of r equal to 0.48.

Choice Symmetry - Char. No. 20

This characteristic was developed in a manner similar to Char. No. 19 that is it was the sum of Char. Nos. 14, 16, and 18. Its mean value was 1.29 and its r value was .28, indicating significant correlation.

Managerial Attributes - Char. No. 21

The characteristic defined here was based upon analysis of the preference ranking given in response to question 8. The measurement is of the distance of the individual's ranking from the mean ranking for the whole study group; the technique of calculating this distance is given in Appendix 7. The variable is an indication of how close to the group mean the individual's response was and therefore is an indication of how well his opinion on this topic matches the group. The mean value for this characteristic was 3.63. Its correlation coefficient was equal to 0.10 and was not significant.

The mean ranking indicated ties between those attributes the participant felt were most important and a tie between those it felt were least important. Participant No. 8 was the only one to agree completely with the consensus ranking, which is:

8. How would you rank the importance of the following characteristics in recognizing a good manager in a company and community such as this one?

Rank

4.5 a. His general standing in the community.

1.5 b. The respect in which he is held by his subordinates.

1.5 c. The respect and recognition given him by his fellow managers.

4.5 d. The recognition given him throughout industry, possibly due to research, publications, or participation in professional activities.

3.0 e. The recognition given him by his superiors.

Managerial Philosophies - Char. No. 22

This variable was determined from the responses to question 9, which required ranking of some descriptionsof managerial philosophies (25). The analysis was performed by the same technique is for Char. No. 21. The mean of this variable was 4.82, indicating a greater range of opinion than for Char. No. 21. Its correlation coefficient, however, was r = -0.04 indicating non-significance.

The mean or consensus ranking had several ties and was not identified by any of the participants. It was:

9. How would you rank the following 'philosophies of management' in terms of the type likely to be used by good managers in companies and communities such as this one?

Rank

1.5 a. Adequate organization performance is possible through balancing the necessity to get out work with maintaining morale of people at a satisfactory level.

3.5 b. Thoughtful attention to needs of people for satisfying relationships leads to a comfortable friendly organization atmosphere and work tempo.

3.5 c. Efficiency in operations results from arranging conditions of work in such a way that human elements interfere to a minimum degree.

1.5 d. Work accomplishment is from committed people; interdependence through a 'common stake' in organization purpose leads to relationships of trust and respect.

5.0 e. Exertion of minimum effort to get required work done is appropriate to sustain organization membership.

Peer Attitudes - Char. No. 23

The same type of variable was calculated from responses to Question 12. Its mean was 6.32 and it was not significantly correlated within the IPI ($r = -0.08$).

The mean ranking was given by Part. No. 60 and was:

12. How would you rank the following personal attitudes in relationship to those likely to be held by successful managers and professionals in situations similar to your own?

Rank

2.5 a. Quality of work is of prime importance. Change is not a desirable thing when the system is operating smoothly. Knowing the job and performing satisfactorily are important goals to be achieved and maintained. Specific direction should be provided by higher levels in the organization.

2.5 b. Lack of fears of survival, of the boss, or social disapproval. Confident of his ability to survive. Sees his task as getting the job done, not getting it done in a certain way. Places emphasis on his own self-esteem. Resists standard procedures and desires work independence. Lacks any strong group loyalty.

2.5 c. Strong desire for fairness. Desire for comformity and stability. Favors a team approach to problem solving. Recognition within the group considered very important. A congenial work atmosphere and comfortable work pace are very important.

2.5 d. High energy level. Security is achieved through hard work. Ends justify means, risk is inherent in good performance. Believes in the power of self. It is the right of leaders to set the rules. Organizational power is an important measure of ability. Performance justifies 'beating the system' and challenging all policies and procedures.

5.0 e. Work is required to provide basic needs. Understanding of the work situation is not required. Performing as demanded in order to fulfill needs is the only important requirement that work makes. Complete subordination to superior power and susceptible to force.

Subordinate Attitudes - Char. No. 24

Responses to question 13 were evaluated by the same method as previously discussed. Its mean was 6.55 and it was not significant ($r = -0.08$). The consensus ranking was the same as Char. No. 23.

Superior Attitudes - Char. No. 25

This variable, in response to question No. 14, was similarly evaluated. Its mean was 6.57 and it also was not significant ($r = -0.02$). The consensus ranking was also the same as that for Char. No. 23.

Training - Char. No. 26

Question 15 asked the participants to report past training sessions, conferences, etc. which they participated in. The responses were coded on a 0 to 5 scale depending upon the range, depth, and recentness. The mean value assigned was 2.52 and was significantly correlated with the IPI with $r = 0.45$.

Creativity Indegree - Char. No. 27

Question 16 and 17 asked the participant to identify creative members of the organization. No selection criteria were provided. This variable is the indegree of those responses, that is, the number of times a person was identified by others as being creative. The mean value was 4.18. The variable was significantly correlated with the index, having a correlation coefficient of 0.35.

Contact Hours - Char. No. 28

The participants had varying opportunity to express their perceptions, ranging of one to three hours depending upon the group they were in. The mean interview time was 1.52 hours and it was significantly correlated with the index ($r = 0.56$).

Number of Memberships - Char. No. 29

Another variable was determined from the responses to question 2. For Char. No. 9 responses were rated, for this variable responses were only counted, no evaluation of their meaningfulness to the work situation was made. The resulting characteristic had a mean of 1.91 and was significantly correlated with the IPI ($r = 0.46$).

Managerial Attribute Correlations - Char. No. 30

In this characteristic, as well as the following four, questions previously evaluated were reviewed from a different standpoint. Each of these responses was a ranking and the number of other participants' rankings that were significantly correlated with it, using the Spearman rank correlation coefficient, ρ, were counted and became the desired measurement. In this characteristic, it was responses to question 8. The mean number of significant correlation per individual was 19.14 indicating fairly high agreement among the participants. This was not significantly correlated with the index, however ($r = 0.03$).

Managerial Philosophies Correlations - Char. No. 31

With responses to question 9, the mean number of significant correlationswas 12.49 which was not significantly correlated with the IPI, as r was equal to -0.01.

Peer Attitude Correlation - Char. No. 32

Using responses to question 12, the mean was 7.32 and was not significant, r = -0.06.

Subordinate Attitude Correlation - Char. No. 33

Question 13 responses has a mean value of significant correlations of 6.22 and was also not significant, r = -0.24.

Superior Attitude Correlations - Char. No. 32

Responses averaged 5.69 significant correlations and the variable was not significantly correlated with the index, r = -0.08.

Status Index - Char. No. 35

The measurement made for the characteristic was the result of the development of a status index as described in Appendix 10. For this analysis, status was positional status as determined by the number of managers and professionals in the hierarchy headed by the individual. The values generated by the model range from zero for an individual with no subordinates of the above type, to 1003 for the Vice President - manufacturing. The mean value was 33.46 and the characteristic was significantly correlated with the Individual Perception Index, having an r = 0.33.

The following characteristics were significantly correlated with the IPI at the 5% level of significance:

Char. No.	Title	r
6	Managerial Level	0.52
7	Achievement Index	0.35
8	Business Contacts	0.43
9	Memberships	0.47

10	Reading	0.33
11	Social Indegree	0.32
13	Discussion Indegree	0.48
15	Advice Indegree	0.42
18	Project Symmetry	0.25
19	Choice Indegree	0.48
20	Choice Symmetry	0.28
26	Training	0.45
27	Creativity Indegree	0.35
28	Contact Hours	0.56
29	Number of Memberships	0.46
35	Status Index	0.33

The initial conclusion to be reached is that these items are the determinants of the perception results for an individual. The greatest correlation is, however, with the number of contact hours, which is a variable that was determined by the conduct of the study. The second highest is Managerial Level, but if its correlation with contact hours is examined, it is found to be 0.79, certainly significant. Obviously, as has already been noted, the higher level managers had the longest contact time in the study. Carrying thisline of inquiry further, managerial level can be seen to be significantly correlated with the following characteristics to the following (all significant) degree:

Char. No.	Title	r
1	Years of Formal Education	.28
2	Years with the Company	.28
3	Age	.60

4	Age started at Company	.47
5	Years of other Experience	.39
8	Business Contacts	.39
9	Memberships	.31
10	Reading	.38
11	Social Indegree	.31
13	Discussion Indegree	.70
14	Discussion Symmetry	.35
15	Advice Indegree	.74
16	Advice Symmetry	.41
17	Projects Indegree	.53
18	Project Symmetry	.34
19	Choice Indegree	.75
20	Choice Symmetry	.39
23	Peer Attitudes	.26
24	Subordinate Attitudes	.31
26	Training	.52
27	Creativity Indegree	.52
28	Contact Hours	.79
29	Number of Memberships	.33
35	Status Index	.54

Reviewing these correlations, two particular, and perhaps not surprising conclusions can be reached. The first is that the higher level managers had more opportunity for outside contacts, training, reading, memberships, etc. (Char. Nos. 8, 9, 10, 26, 29). These might be characteristics that contributed to the individuals obvious success, or they might be privileges of rank. The second is that an individual, when asked to name other people in the organization, tends to name individuals at the higher levels. All of the characteristics that reflected this indicates a high correlation with managerial level. (Char. Nos. 11, 13, 15, 17, 19, 27). While those that indicated reciprocity in this identification (12, 14, 16, 18, 20), has correlation coefficients that were either not significant or were considerably smaller than the corresponding coefficient for one-way identification. An example: managerial level is correlated with both Discussion Indegree (13) and Discussion Symmetry (14), but the correlation coefficients are 0.70 and 0.35 respectively.

If some of the effect of managerial level is removed by developing a ratio of Individual Perception Index divided by Contact Hours (IPI/Char. No. 28) a considerably different relationship picture is developed. The following are the significant correlations:

Char. No.	Title	r
2	Years with the company	-.25
3	Age	-.32
15	Advice Indegree	-.27
33	Subordinate Attitude Correlation	-.25

The variable IPI per contact hour appears to be generally uncorrelated with this set of characteristics. In general, it indicates that the longer an individual is with the company, and the older he is, and the more he is sought for his advice and wisdom, the less likely he is to be one of the more perceptive individuals in the organizations from the standpoint of identifying numbers of improvement needs. The relationship between these indices and the characteristics can also be examined as a group using techniques of multivariate analysis.

Multivariate Analysis of Individual Perception Index

The previous section describes the relationship between individual characteristics and the Individual Perception Index (IPI). It is also reasonable to consider the relationships between groups of characteristics and the IPI. The technique used was a stepwise multiple correlation and regression program of the type described by Draper and Smith (26). The objective of this type of technique is to select the "best" regression model which describes the relationship between the dependent variable the the independent variables. The adjective "best" indicates that a unique statistical procedure is not available for accomplishing this. The dilemma faced in determining this "best" model is that with more and more independent variables in the model the reliability of its predicted values increases, however, with this increase go along associated increases in the cost of obtaining and maintaining these independent variables. The stepwise procedure is one of several described by Draper and Smith (26) and is the one recommended by these authors after their review and analysis of the more widely used techniques.

The stepwise procedure selects the one best independent variable for the regression model. It then selects the next best variable and brings it into the model. The selection criterion is the contribution of that variable in explaining variance of the dependent variable, as measured by the partial correlation coefficient for the new variable. At each stage in the development of the model, each variable already in the model is evaluated to provide a judgement on its contribution and to determine if it should be dropped from the model or should remain. The evaluation is carried out by calculating a partial F criterion for each variable and comparing it to some preselected confidence level on the appropriate F distribution. The net result of this approach is that a variable may enter the solution at an early stage and leave at some later stage because of the relationships between the variable and other variables entered in the current solution. The procedure continues to develop improved regression models until none of the remaining variables can be admitted to the solution based upon the preselected confidence level criterion.

The approach followed in this study was to start with a high confidence level criterion and then to relax this criterion in steps. The result are shown in Table 14. These results indicate a high degree of relationships among the variables themselves, as evidenced by only five variables being in the solution at the 70% confidence level and all variables being in the model at the 60% level. The 70% model included characteristics Nos. 3, 6, 7, 9, and 28, which are:

Char. No. 3	Age
Char. No. 6	Managerial Level
Char. No. 7	Achievement Index
Char. No. 9	Membership
Char. No. 28	Contact Hours

The regression equation is:

$$IPI = 169.74 + 10.046_3 - 50.276_6 + 57.106_7 + 8.836_9 + 26.856_{28}$$

The general indication resulting from this analysis is that the IPI is related to the age of an individual, his level in the organization, how fast he has reached that level and his memberships, perhaps a measure of current education. Also the IPI was influenced by the number of

Table 14 IPI Multiple Regression Results

CONFIDENCE LEVEL CRITERION	VARIABLES IN SOLUTION	MULTIPLE CORRELATION COEFFICIENT	COEFFICIENT OF DETERMINATION	STANDARD ERROR OF ESTIMATE	OVERALL F VALUE	F VALUE SIGNIFICANCE 0.05 LEVEL
.90	3 6 7	.52	.27	27.42	7.57	2.76
.80	3 6 7 18	.56	.32	26.80	6.91	2.53
.70	3 6 7 18 21 30	.62	.38	25.96	5.89	2.25
.60	2 3 6 7 9 10 14 17 18 20 21 30	.72	.53	23.96	4.80	1.92
.50	All	.81	.66	22.68	1.72	1.74

Table 15 IPI/Contact Hours Multiple Regression Results

CONFIDENCE LEVEL CRITERION	VARIABLES IN SOLUTION	MULTIPLE CORRELATION COEFFICIENT	COEFFICIENT OF DETERMINATION	STANDARD ERROR OF ESTIMATE	OVERALL F VALUE	F VALUE SIGNIFICANCE 0.05 LEVEL
.90	28	.56	.32	34.70	28.98	4.00
.80	3 6 7 28	.69	.48	30.97	13.86	2.52
.70	3 6 7 9 28	.73	.53	29.73	13.25	2.37
.60	All	.90	.81	26.78	3.66	1.79

contact hours. In an effort to offset the effects of contact hours and managerial level, as discussed previously, another regression analysis was run using the ratio [IPI/Contact hours] as the dependent variable.

Table 15 gives the results for the regression analysis on this ratio. These results are quite similar to the previous results in that a high confidence level results in a model with a low coefficient of determination. The regression model for this equation that is comparable with a previous model is that at the 70% level.

The resulting regression model is:

$$IPI = 620.52 - 27.176_3 + 134.106_6 - 131.116_7 + 7.066_{18} - 1.176_{24} - 0.456_{30}$$

The variables are:

Char. No.	3	Age
Char. No.	6	Managerial Level
Char. No.	7	Achievement Index
Char. No.	18	Project Symmetry
Char. No.	21	Managerial Attributes
Char. No.	30	Managerial Attributes Correlations

Figures 9 and 10 present analysis of the residuals based upon the two 70% regression models. Comparison of the two charts of residuals indicates that the two regression models are very similar in their prediction. Only 12 of the 65 pairs of residuals change sign from one model to the other and these are all in the case of small residuals. Also, outliers in one model are also outliers in the other model. (Part. Nos. 10, 45, 63, for example). Another plot of residuals is shown in Figure 11. In this case, residuals are plotted against the value of the IPI calculated using the regression equation. This plot has no overall pattern which would tend to invalidate the regression analysis. From these analyses

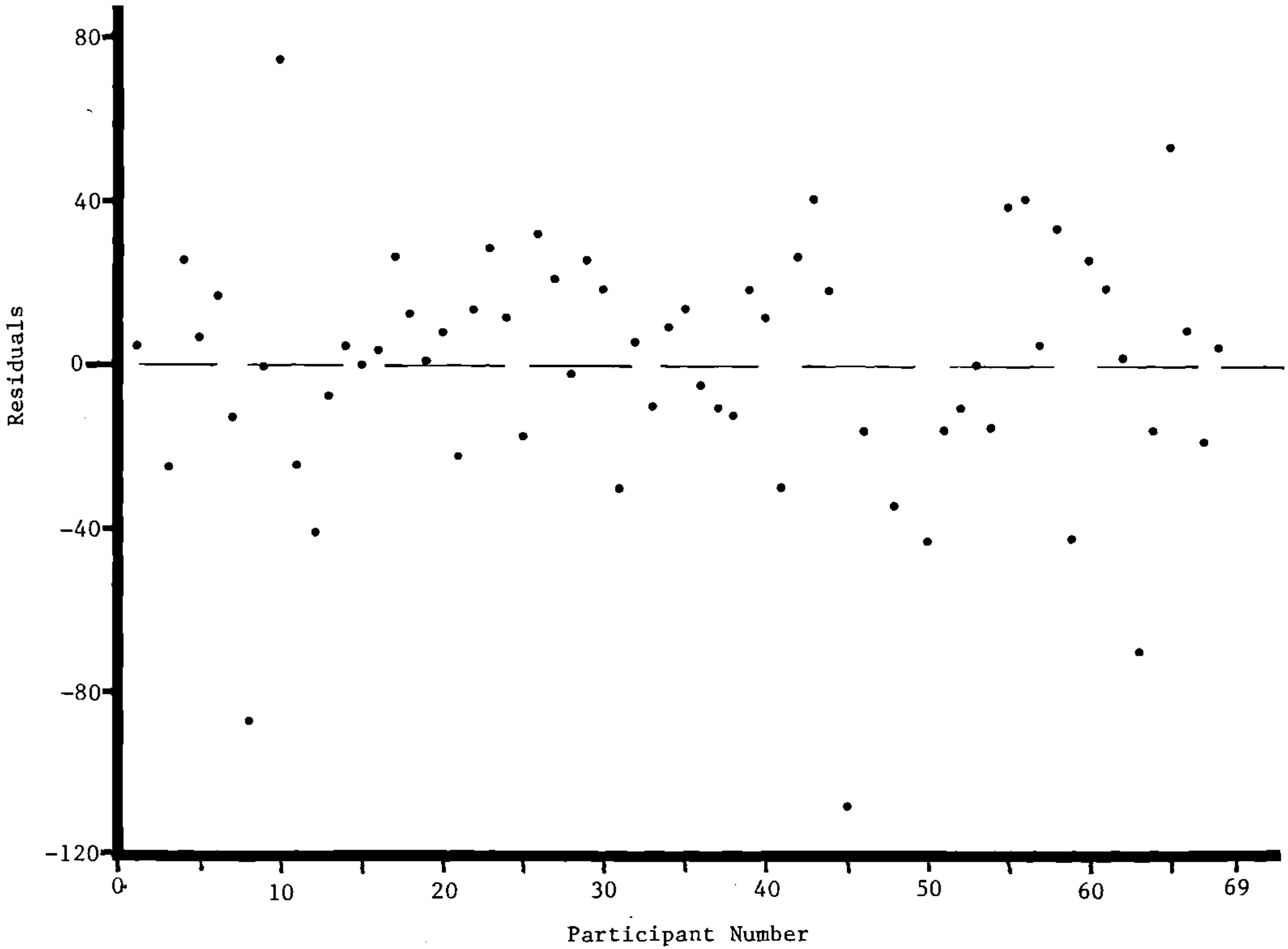


Figure 9 Residuals from IPI Regression Analysis

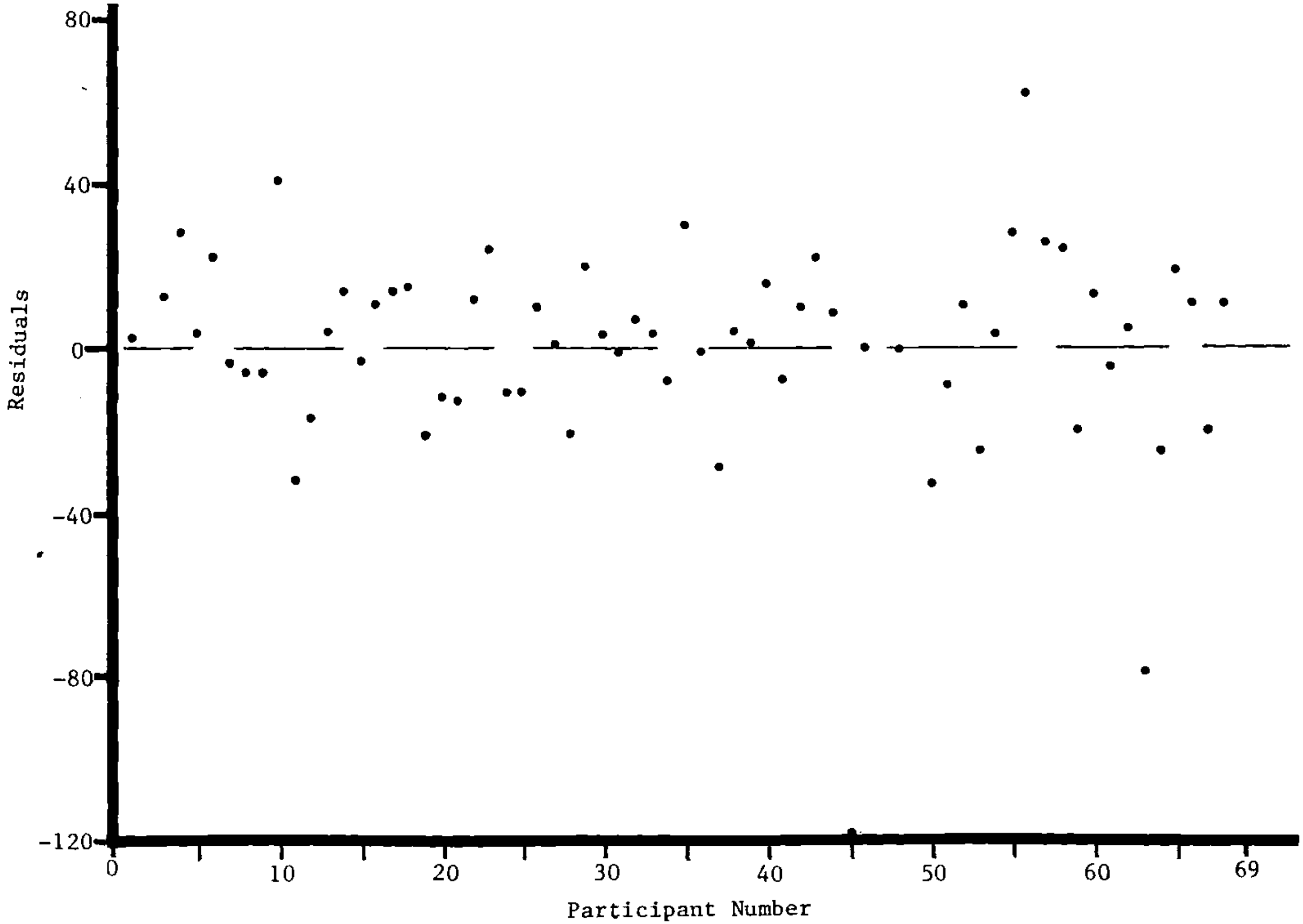


Figure 10 Residuals from IPI/Contact Hours Regression Analysis

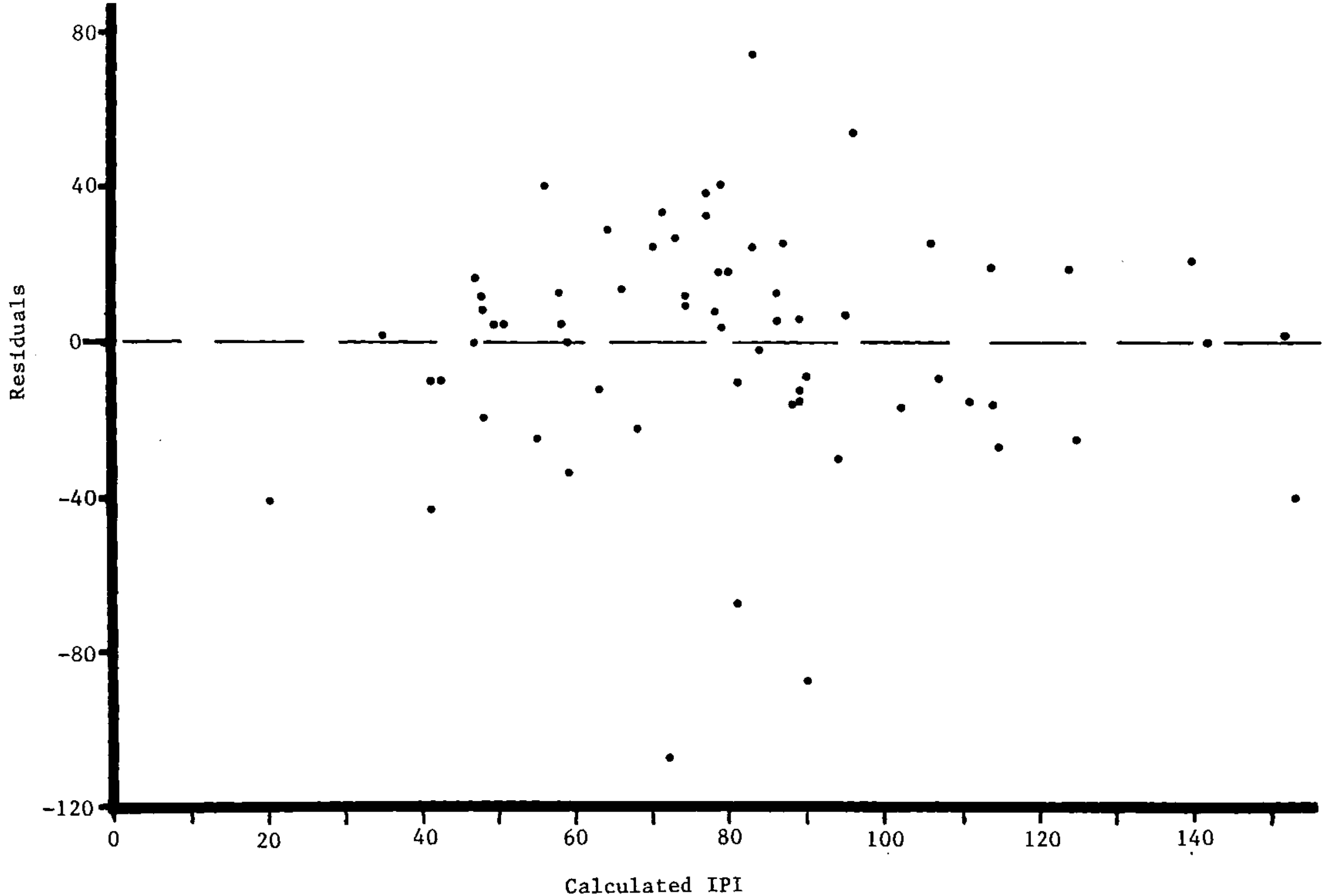


Figure 11 Residuals versus Calculated IPI

of the residuals it is evident that the regression analysis has been applied properly and is reasonably complete, considering the low 70% confidence level.

The conclusion to be reached, however, in these analyses is that none of these characteristics can serve as a useful predictor of the value of an individuals perception. Likewise in groups, the characteristics have little value in predicting this measure of individual performance. Throughout the analysis, it is evident that results could be much improved by throwing out some of the outliers, that is, excluding some of the extreme values from the analysis. But no justification for taking this action can be developed. The outliers are valid observations and must be included even though they are an obstacle to straight forward analysis.

CHAPTER VI

ANALYSIS OF NEEDS PERCEIVED AS RELATED TO INDIVIDUAL CHARACTERISTICS

In the previous chapter, the relationships among the characteristics were discussed as were their relationship with a measure of the performance of participants, the Individual Perception Index. The association studied was how the characteristics affected or were related to how much an individual perceived. In this chapter, a different relationship will be examined. Of concern here is how do scores on these various characteristics coincide with what the individual perceives. The approach used in this analysis is to determine whether classes formed on the basis of scores on a particular characteristic have strong patterns of common need identification.

Identification of Classes by Characteristic

The technique followed in developing classes was as follows. The scores for each characteristic were examined and a number of classes developed, up to a maximum of 20. The selection attempted to provide reasonable differentiation between classes on the basis of scores for the characteristic while still developing sets of individuals that could logically be classed together.

After the classes were developed, and the individual members of each class identified, an analysis to determine the degree of agreement among classes was performed. This technique was the GRPCOR technique developed and described in Appendix 9. The GRPCOR model developed two vectors for each class which were indicative of how the individuals as a class perceived the needs of the organization. The vectors have 80 components, each related to one of the 80 needs identified. The elemental values of the first or average vector are the average perceptions of the need by the individuals in the class. For example, if two out of the four individuals in a class identify a particular need, the corresponding component in the average vector is 0.5. The second vector was labeled the zero-one vector and was the result of assigning zero or one to the particular component depending upon whether no one in the class or at least one in the class identified that need. These vectors were then used as the measure of the perceptual results of that particular class. The average vector indicated the general agreement among the individuals making up the class as well as what needs were perceived. The zero-one vector indicated the perceptual results that might reasonably been expected if the individuals in the class had been asked to work together and to come up with a list of improvement needs.

The analysis of the two sets of vectors, each set consisting of a vector for each class, was performed by determining the correlation coefficients for each pair of vectors. The result was a matrix of product moment correlation coefficients, r, for the average vectors and a matrix of product-moment correlation coefficients, ϕ, for the zero-one vectors. In addition, significance matrices were calculated for each correlation matrix which indicated if the correlation coefficient for the particular pair of vectors was different from zero at either the 5% or 1% level of significance.

For this portion of the study the zero-one (ϕ) correlation matrix was examined to determine if there were any particularly meaningful patterns to the correlations that would indicate strong differences in needs identified by different classes. In addition, the correlation matrix was subjected to an inverse factor analysis study. Factor analysis is a technique for analyzing the intercorrelations within a set of variables. The objective is to isolate and identify a limited number of hypothetical variables or factors, that underlie the set of observed variables. The algorithm used in this study was the principle-components analysis which identified a small number of independent factors by which the correlation matrix of the observed variables could be reproduced as closely as possible. (27) The algorithm also included a Varimax routine by which the axes from the principle-component solution were rotated. The rotation results in a set of orthogonal (uncorrelated) axes which maximizes the variance explained by the factor loadings. This is the most widely used of the available rotational schemes and results in solutions that are relatively unvariant in comparison to other rotation schemes and one in which minor changes in the samples do not affect the basic inference drawn. (28) The purpose of rotation of the axes is to provide a set of orthogonal factors which might provide a better definition of the original sample space, only with reduced dimensionality. This is done without reducing the proportions of the original variance explained by the factor analysis (23).

The typical factor analysis is concerned with the reduction of number of variables in samples to some fewer number of factors which may provide particular insight into the phenomenon being studied. In this study the method was used in an inverse manner. Instead of reducing the number of needs (variables) factor analysis was used to reduce the number of perceiving classes. The result is a set of correlations (or factor loadings) between the classes and the factors which can be evaluated for significance using methods proposed by Harman (29). The number of factors rotated was limited to factors corresponding to latent roots of the correlation matrix greater than one, a constraint proposed by Harman (29) as well as Cooley and Lohnes (28).

Because of the nature of inverse factor analysis, those classes that are highly correlated tend to be associated with the same factor, that is, have significant factor loadings. Therefore if the analysis indicated that classes at one end of the scale for the characteristic were associated with a different factor from classes at the other end of the scale, then the actual needs identified by the classes would be reviewed to determine their differences. On the other hand, if the factors were composed of classes from both ends of the characteristic scale, the indication would be that classes rating both high and low in that characteristic tend to identify the same improvement needs.

The analysis was performed for all characteristics lending themselves to meaningful evaluation by this method. Several of the characteristics were not evaluated because of the nature of the set of values assigned for the characteristic was such that meaningful classes of reasonable size could not be established. A maximum class size of twenty was established which reflected an arbitrary decision that groups or classes larger than this maximum could not be considered as being meaningfully different from the study group, which numbered 69. An attempt was also made to have the class size exceed three wherever possible.

The analysis will be described in considerable detail for the first characteristic. Discussions of subsequent analyses will then carry only the level required to describe the particular results.

Results of Analysis

Years of Formal Education - Char. No. 1

The following classes were identified by response to the questionnaire:

Class No.	Years of Formal Education	Participants in Class
1.	Less than 12	{40}
2.	12	{1, 4, 5, 11, 23, 31, 32, 37, 38, 42, 44, 48, 52, 62, 66, 67, 68}
3.	13	{9, 13, 14, 17, 20, 35, 18, 45}
4.	14	{6, 7, 16, 22, 57, 60}
5.	15	{12, 33, 53}
6.	16	{3, 8, 15, 24, 26, 27, 28, 30, 34, 41, 46} {51, 54, 58, 59, 61, 63, 64, 65}
7.	16 1/2	{39, 43, 50, 25, 55}
8.	17	{10, 21, 29, 36, 56}
9.	more than 17	{19}

Because this portion of the study was concerned with the differences in the improvement need sets identified by different groups or classes, the zero-one analysis was used. On the basis, the class was said to have identified a need if one or more of the participants in that class identified the need. The resulting correlation matrix for these classes is shown in Table 16, along with its corresponding significance matrix. Review of this table does not indicate any strong patterns of relationship in regard to characteristic values. The INFAC factor analysis of this correlation matrix resulted in identification of three factors with the following loadings (correlations between the class vector and the hypothetical factor vector) for each class:

Class	Factor I	Factor II	Factor III
1	-.79*	.06	-.05
2	-.41	-.15	.58*
3	-.25	-.32	.64*
4	-.61*	-.15	.32
5	.34	-.51*	.32
6	.07	-.22	.65*
7	-.22	-.18	.51*
8	-.31	-.73*	.11
9	.04	-.84*	.06

Those loadings identified by asterisk are significantly different from zero at the 1% level by the method described by Harman (29). Analyzing these loadings, those classes that are identified as being close together in need identification are:

<u>Factor Members</u>

I -{1, 4}

II -{5, 8, 9}

III -{2, 3, 6, 7}

Table 16 Correlation Analysis - Years of Formal Education Classes

Correlation Matrix

	1	2	3	4	5	6	7	8	9
1	1.00	.17	.08	.28	-.14	.02	.08	.13	-.03
2		1.00	.49	.33	.16	.21	.30	.27	.13
3			1.00	.31	.21	.39	.33	.34	.24
4				1.00	.10	.16	.24	.24	.10
5					1.00	.23	.13	.15	.31
6						1.00	.26	.24	.19
7							1.00	.17	.19
8								1.00	.47
9									1.00

Significance Matrix

	1	2	3	4	5	6	7	8	9
1		.00	.00	.01	.00	.00	.00	.00	.00
2			.01	.01	.00	.05	.01	.01	.00
3				.01	.05	.01	.01	.01	.05
4					.00	.00	.05	.05	.00
5						.05	.00	.00	.01
6							.05	.05	.05
7								.00	.05
8									.01
9									

The conclusion to be reached here is that the years of formal education for a participant did not affect the particular set of needs that the individual identified. If such a relationship had existed, classes at each end of the scale would have been identified with separate factors, such as

Factor Members

I -{1, 2, 3}

II -{3, 4, 5}

III -{6, 7, 8}

Table 17 gives the improvement needs identified by each of the classes on the basis of a single identification being equivalent to class identification.

Years with the company - Char. No. 2

Age - Char. No. 3

Age started at company - Char. No. 4

Years of other experience - Char. No. 5

These four characteristics were analyzed in the preceding manner and resulted in the same conclusion, that the needs identified were not meaningfully related to classes formed from these characteristics. For example, the participants whose first employment was with the company and therefore had no other experience did not identify a set of needs that was significantly different from the need set identified by participants who had had considerable outside experience.

Managerial Level - Char. No. 6

To analyze the improvement need identification as it might be related to the organizational level of the participant, the following

Table 17 Needs Identified by Education Classes

CLASS	NEEDS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	411	435	452	562	574																
2	123	124	221	222	231	311	313	321	323	324	326	331	332	333	334	335	411	412	421	422	423
3	122	123	124	221	222	231	311	313	321	324	326	329	332	333	335	411	412	421	424	425	431
4	123	231	311	313	324	326	331	335	411	412	424	431	434	435	436	451	452	454	511	521	522
5	221	231	311	326	328	332	335	432	436	441	451	511	512	521	533	551	571	572			
6	111	121	123	124	221	222	231	311	313	322	326	327	328	329	332	333	334	335	411	412	421
7	122	123	124	311	313	323	325	329	332	335	411	412	424	425	432	434	436	441	445	451	452
8	111	123	124	211	221	231	311	321	326	329	331	411	424	425	431	432	435	436	441	453	521
9	111	211	221	222	231	311	329	411	412	424	425	431	432	436	441	451	511	515	521	532	

CLASS	NEEDS 22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
1																					
2	424	425	431	432	435	436	441	442	445	451	452	454	511	513	514	521	522	531	532	533	541
3	432	435	436	441	442	443	445	451	511	512	513	514	521	522	531	532	541	542	543	551	553
4	531	532	541	543	552	553	561	562	563	565	569	571	572	573	574	577					
5																					
6	423	424	425	431	432	433	434	435	436	441	442	443	444	445	451	453	511	512	513	514	521
7	511	514	531	532	533	541	542	543	551	552	553	561	562	569							
8	522	532	541	542	543	562	569	571													
9																					

CLASS	NEEDS 43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
1																					
2	542	543	551	553	561	562	564	568	569	571	573	574	575	577							
3	561	562	563	565	566	568	569	571	573	574											
4																					
5																					
6	522	531	532	533	541	542	543	551	552	553	561	562	565	567	569	571	573	574	577		
7																					
8																					
9																					

classes were established:

Class	Level	Participants in Class
1	1	{30, 37, 39, 52, 56, 57, 62}
2	2	{6, 8, 18, 33, 40, 45, 50, 53, 67, 68}
3	3	{1, 9, 11, 12, 13, 20, 21, 22, 23, 24, 26, 34, 42, 43, 48, 49, 55, 63, 64, 66}
4	4	{2, 4, 5, 14, 16, 17, 25, 27, 28, 29, 31, 32, 35, 38, 41, 44, 46, 51, 65, 69}
5	5	{7, 15, 36, 47, 54, 59, 60, 61}
6	6,7	{3, 19}

The managerial level has been shown to be significantly correlated with the Individual Perception Index in the previous chapter, therefore it is not unexpected that the mean IPI for these classes increases as follows.

Class	Mean IPI
1	50.7
2	79.1
3	66.2
4	88.3
5	115.3
6	149.9

The number of needs identified by the classes appears, from the following list, to be related to the number of people in the class, as shown in the table below:

Class	Number of Participants	Number of Needs Identified
1	7	37
2	10	54
3	20	59
4	20	66
5	8	52
6	2	28

However, while the number of needs identified does increase with the number of members in the class, it apparently does not preclude a class from having a different set of identifications. Note that in reviewing the zero-one correlation matrix given in Table 18, it can be seen that class 1 is limited in its relationship with the other classes. In contrast, class 6 is significantly correlated (5% level) with all classes except class 1 even though it identified only 28 needs.

The INFAC analysis indicated the same results obvious from the above discussion; two factors were identified, one including Class 1 only and the other, Classes 2 through 6. Comparing Class 1 to the others can be best done by examining the needs that were either uniquely identified or not identified by this class. In the first case there were none, that is, this class did not identify any needs that were not identified by at least one other class. In the second case, they failed to identify eight needs that were identified by all the other classes. These are:

326 Establish Operations Research - Systems Analysis function
329 Establish an improvement function
411 Manpower planning technique
412 Plan for organizational change due to retirements
432 Training programs in management techniques - Staff
435 Training in new technology for line management
436 Training in new technology for staff personnel
511 Performance measurement system

Table 18 Correlation Analysis - Managerial Level

Correlation Matrix

	1	2	3	4	5	6
1	1.00	.11	.33	.30	.16	.11
2		1.00	.37	.03	.39	.29
3			1.00	.32	.34	.32
4				1.00	.21	.20
5					1.00	.26
6						1.00

Significance Matrix

	1	2	3	4	5	6
1		.00	.01	.01	.00	.00
2			.01	.00	.01	.01
3				.01	.01	.01
4					.05	.05
5						.01
6						

The implication is that this group was different from the rest of the organization in three basic ways:

a. They did not recognize the needs related to the technological requirements in the organization, both from a functional organization standpoint as well as a training viewpoint.

b. They did not recognize any specific organization structural change requirements nor any manpower planning and personnel acquisition requirements.

c. They did not recognize the need for planning for upcoming retirement, possible because of their level in the organization. The retirements referred to (#412) occur mainly in the top levels of the organization.

These results would seem to be reasonable in that the lower levels in any organization have limited exposure to the problems that higher levels may be vitally concerned with.

Achievement Index - Char. No. 7

The Achievement Index was also significantly correlated with the IPI but not to the extent of the previous characteristic. The existing mean IPI for classes formed by Achievement Index are as follows:

Class	Mean IPI
1	66.7
2	61.9
3	83.7
4	63.4
5	72.4
6	103.0
7	101.0

However, the resulting correlation analysis indicates that in terms of needs identified all the groups are highly intercorrelated with the resulting conclusion that there is no relationship between classes based upon this index and the types of improvement needs perceived by their classes.

<u>Business Contact - Char. No. 8</u>

<u>Memberships - Char. No. 9</u>

<u>Reading - Char. No. 10.</u>

None of these three characteristics demonstrated any strong relationship with the types of improvement needs perceived. The classes identified by membership type and extent (Char. No. 9) suggested a difference between the needs perceived by classes of participants who were members of active technical or professional organizations and those whose organizations were less technical or of more general membership.

Social Indegree	-	Char. No. 11
Discussion Indegree	-	Char. No. 13.
Advice Indegree	-	Char. No. 15
Projects Indegree	-	Char. No. 17
Choice Indegree	-	Char. No. 19
Choice Symmetry	-	Char. No. 20.

None of these characteristics, all associated with the interpersonal contacts among the participants, yielded classes that could be meaningfully differentiated. These measures were indicative of the extensiveness of interpersonal contacts, but classes made up of participants with considerable contacts did not identify different types of needs when compared to classes made up of participants with few reported contacts.

Managerial Attributes - Char. No. 21

Managerial Philosophies - Char. No. 22

Classes formed based on the distances from the mean for these characteristics did not indicate that individuals with rankings near the consensus ranking identified different sets of improvement needs compared to those classes whose rankings were further from the mean.

Training Char. No. 26

The training characteristic was significantly correlated with the IPI, so as was expected, the mean IPI for the classes formed showed the following behavior:

Class	Mean IPI
1	53.7
2	64.9
3	70.2
4	81.3
5	88.4
6	128.1

The classes yielding these values were:

Class	Scale Value	Participants in Class
1	0	{14, 40, 52, 68}
2	1	{1, 12, 16, 18, 28, 32, 56, 57, 58, 62, 63, 67}
3	2	{6, 9, 11, 17, 20, 21, 23, 26, 29, 30, 35, 39, 45, 51, 54, 55, 64, 66}

4	3	{5, 8, 13, 22, 24, 25, 31, 33, 34, 38, 42, 43, 50, 53, 61, 65}
5	4	{7, 10, 19, 27, 37, 44, 60}
6	5	{3, 4, 15, 36, 41, 46, 48, 59}

The INFAC analysis resulted in identification of two factors, one made up of classes 1 and 2, the other of classes 3, 4, 5, and 6. Significant (.05 level (29)) factor loadings are as follows:

Class	Factor I	Factor II
1		-.80
2		-.66
3	-.81	
4	-.74	
5	-.49	
6	-.81	

Factor I classes had the following common identifications that were not common to the classes in Factor II:

333 Improved coordination and cooperation - line and staff

421 A management selection program

541 Quality emphasis programs

543 Cost-Quality tradeoff technique

571 Specification standards for new equipment

574 Maintenance management system

577 Tooling control system

This indicates a quality control - facilities orientation for these two classes as compared to the Factor II classes. Factor II classes had considerably more common identifications than Factor I classes, they were:

111, 221, 231, 311, 313, 326, 329, 332, 431, 436,

441, 445, 511, 513, 514, 522, 553, 561, 569, 573

These results show a much broader pattern of identification for the Factor II classes and much more of a staff outlook as compared to the more line-oriented identifications of Factor I classes. The general indication here is that the effect of attendance at training sessions and professional conferences tends to broaden the outlook of the individual and provides exposure to new techniques (such as OR (#326) and Value Analysis (#553)) which he can consider for application in his own environment.

Creativity Indegree - Char. No. 27

This characteristic did not yield groups that indicated differences in improvement needs perceived by persons that were identified as creative by a considerable number of their fellow participants as compared the results shown by those who were named only a few times.

Contact Hours - Char. No. 28

Contact Hours divided the study participants into three classes:

Class	Contact Hours
1	3
2	2
3	1

Class 1 were the top managers that formed the first group (A) of participants, Class 2, the next group (B) of participants and Class 3, the two groups (C and D) of lower level managers. These groupings are identified by individual in Appendix 2.

Class 1 was unique in that they were the only class to identify needs 211 and 515 while at the same time they were the only class that failed to identify 121, 122, 321, 323, 331, 421, 422, 434, 452, 454, 568, 572, and 573.

Class 2 was unique in their identification of 322, 325, 327, 444 and in their lack of identification of 328, 443, 453, 552.

Class 3 failed to identify 334, 423, 563, and 565 when they were identified by the other two classes. Class 3 however was unique in identification of 433, 513, 564, 566, 575, and 576.

In evaluating these results, they can be seen to parallel the result for managerial level classes because of the makeup of the study groups, that is, top managers were in Group A which is Class 1 in this specific analysis. The top managers perceptions can be summarized in four general statements, none of which could be considered unexpected.

a. They recognized growth potentials in terms of manufacturing capability (needs 123, 124, not 121, 122).

b. They recognized the need for broader scale, more general programs (#211, #515) that did not occur to other classes.

c. They had limited recognition of structure needs which are under their control, that is, they apparently were satisfied with the structure and felt no immediate need for change (failure to give strong identification to needs in the 321 - 329 group).

d. Their identifications were centered in areas other than the operational system area, which in turn was more specifically identified by lower levels.

Class 2 was the class that was most interested in change in the organization structure, and the needs of being prepared for position changes. This also is not unexpected for these are individuals who have been successful in the organization and are looking forward to further success. They are watching promotion opportunities and their opportunities only come about by retirement or creation of new responsibilities.

Class 3 showed a broad range of identifications. However, when compared to the other classes they showed a distinct tendency to stress the techniques associated with their work rather than broad organizational needs. This too was not unexpected considering the more limited exposure and company problems and goals which these participants have had in the past.

<u>Number of Memberships - Char. No. 29</u>

<u>Status Index - Char. No. 35.</u>

These two characteristics were the final two that were tested for their relationship to the types of needs perceived. There was no specific relationship resulting from the analysis.

The general conclusion to be reached as a result of these analyses is that the type of needs perceived is not highly related to the characteristics used as a basis for class development. While some relationships were identified, it appears that because of the differences in individual perceptions and more specifically, differences in the number of needs perceived, the relationships among classes were highly dependent upon the number of individuals in a class than on any other specific attribute. This line of reasoning is investigated further in the analysis of the following section. In that section clusters of participants having common perceptions will be investigated for overall characteristics or indications of possible causes for the common perceptions.

CHAPTER VII

CLUSTER ANALYSIS OF INDIVIDUALS BY NEEDS PERCEIVED

Each of the participants identified improvement needs that he felt were crucial to the organization. By defining clusters of participants as individuals having the same need identifications it might be possible to relate what was commonly perceived by the cluster back to the participants in the cluster as a unique group within the organization. The analysis in this section makes use of the cluster model described in Appendix 11.

Perceptions were classed in 80 categories, as described in Chapter IV. Table 9 gave this classification by individual, which ranged from one for Part. No. 10 to twenty six for Part. No. 59. The maximum number of common perceptions occurred between Part. Nos. 45 and 59 (both in Industrial Engineering), who identified 14 needs that were identical. If participants with 13 or more common identifications are examined, a pair made up of Part. Nos. 41 and 59 as well as the first pair, Part. No. 45 and 59, have 13 or more common perceptions (but only nine in common for the trio, 41, 45, 59). Relaxing the requirement to 12 or greater common perception brings in three more participants as shown in Figure 12. Figure 13 shows a continuation of this development by relaxing the requirement to eleven common perceptions. In this figure there are two distinct clusters, one centered around Part. No. 3, the other around Part. No. 59. The first cluster, {3, 19, 54, 63}, has seven perceptions that are in common, 411, 412,

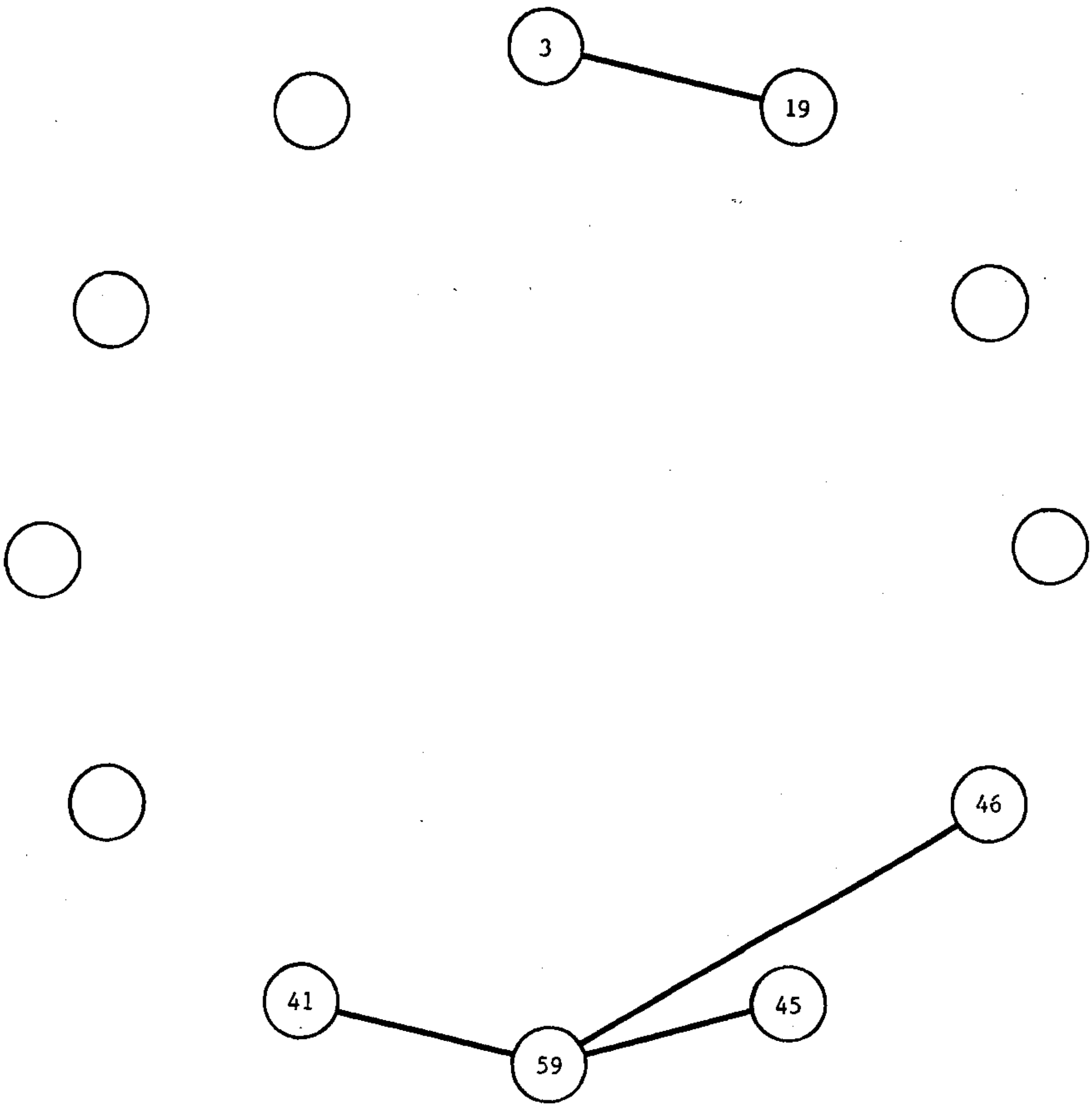


Figure 12 Graph of Twelve or More Common Perceptions

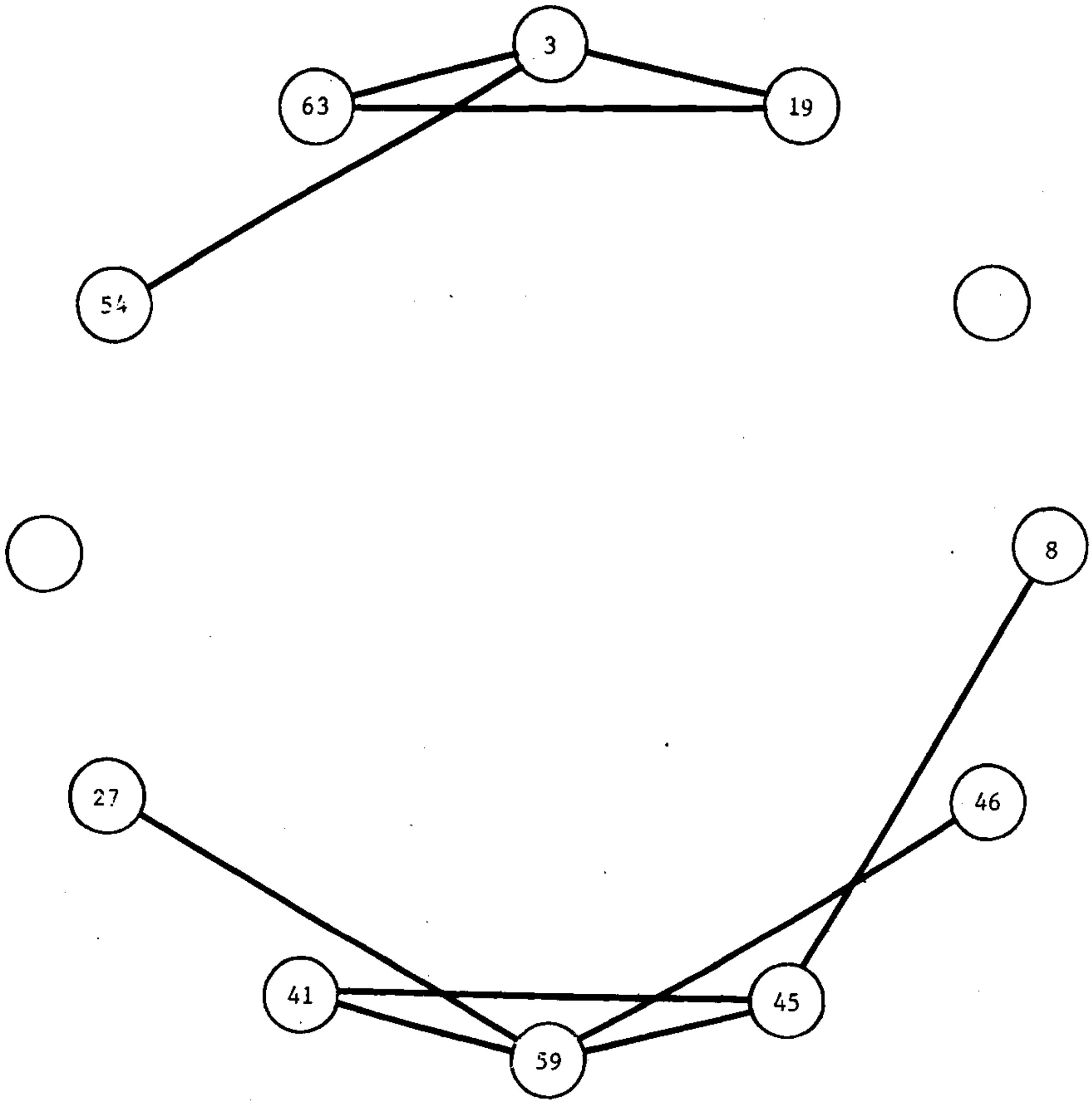


Figure 13 Graph of Eleven or More Common Perceptions

424, 431, 432, 436, 451; all of which have to do with the member problemsof the organization. They are all directed toward management training and development problems and reflect this need in light of the upcoming retirements in the organization. The second cluster {8, 26, 41, 45, 46, 59} has none of the 80 possible perceptions in common. If we restrict the analysis to the three central participants {41, 45, 59}, they have 9 perceptions in common; 311, 326, 329, 335, 411, 424, 511, 522, 562. These indicate a concern for the structure of the organization, manpower problems, and industrial engineering type problems (all three of these participants are industrial engineers).

The next logical step is to relax the common requirement to 10 or greater, Figure 14 shows the results. There are no longer two distinct clusters, but only one with, as might be expected, no perceptions in common to all 12 members of the cluster. Figure 15 shows similar results for the restriction of 9 or more perceptions in common. The difference in Figure 15 is that now there are subgroups or smaller clusters that have considerable numbers of perceptions in common to all their members which are identified by dashed lines. They are {3, 54, 63}, {41, 45, 59}, and {45, 46, 59}, each of which have nine. These common perceptions are:

{3, 54, 63}	{41, 45, 59}	{45, 46, 59}
326	311	311
411	326	326
412	329	436
424	335	445
431	411	511
432	424	512
435	511	522
436	522	553
451	562	563

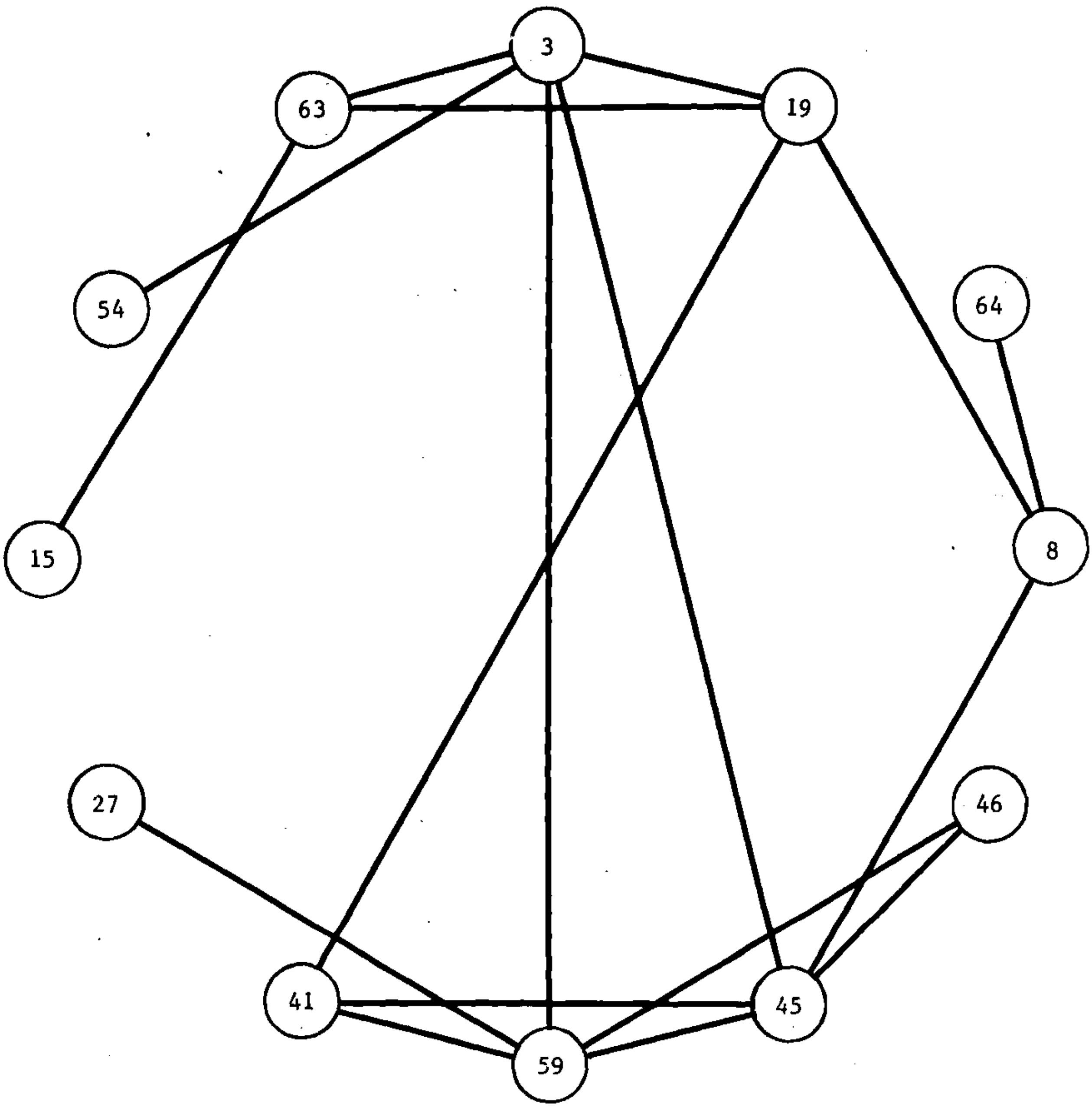


Figure 14 Graph of Ten or More Common Perceptions

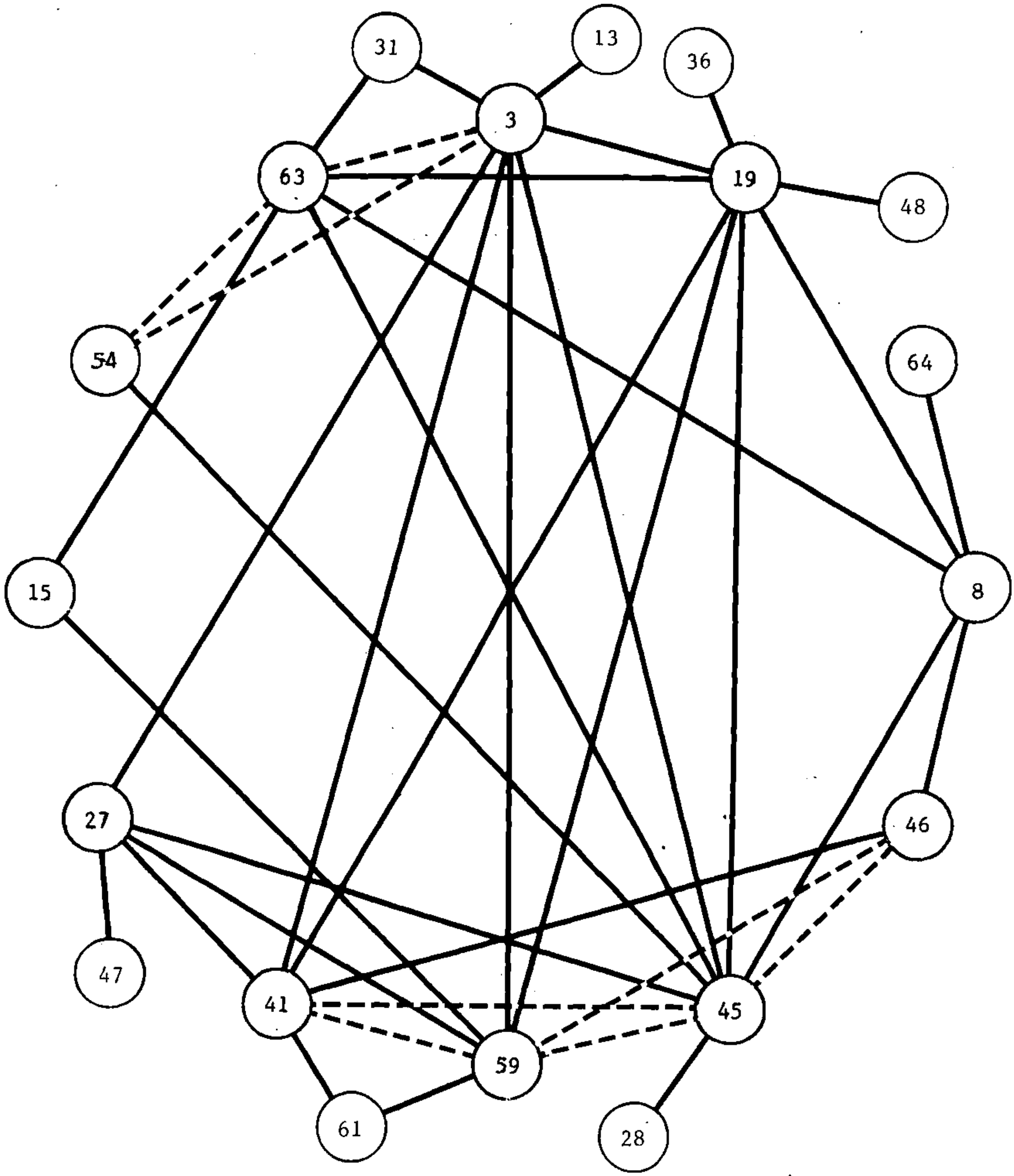


Figure 15 Graph of Nine or More Common Perceptions

For eight or more common perceptions the number of trios increases, they are:

{3, 19, 54}	{19, 41, 59}	{41, 45, 59}	{3, 45, 54}	{45, 46, 59}	{3,54,63}
311	211	311	311	311	326
411	231	326	326	326	411
412	311	329	411	436	412
424	329	335	412	445	424
431	411	411	424	511	431
432	424	424	431	512	432
436	436	511	435	522	435
451	453	522	436	553	436
		562		567	451

As can be seen, as the matching restrictions are continually relaxed, the two original clusters {3, 19, 54, 63} and {41, 45, 59} shown in Figures 12 and 13 are more and more difficult to identify. Table 19 gives the four and five member clusters when the restriction is that the cluster must have 5 or more perceptions in common. Under this same restriction there are approximately 80 additional three member clusters that are not given in the Table. All of these clusters are tied by one or more members to the original two clusters; some are connected to only one, while some are connected to both original clusters.

The apparent conclusion here is that there are two basic clusters among the 69 participants. Each one is centered on one of the original clusters, but they quickly overlap one another. The remaining participants are not particularly close to either of the first two clusters nor to each other. In the following section, another approach to defining clusters is described which confirms this conclusion and permits definition of additional clusters.

Table 19 Clusters of Four or More Participants having Five or More Common Perceptions

CLUSTERS	CLUSTER MEMBERS					COMMON PERCEPTIONS					
1	2	41	45	46	59	311	326	511	522	562	
2	3	19	54	63	32	411	412	424	432	436	
3	32	3	19	63	31	411	412	432	436	441	
4	45	3	54	63	19	411	412	424	431	436	
5	28	45	59	46		326	436	445	522	553	562
6	3	45	59	41		311	326	329	411	424	
7	7	19	3	41		231	311	411	451	532	
8	8	19	63	3		412	432	436	441	451	
9	11	27	59	21		231	326	424	436	562	
10	13	3	63	54		326	424	431	435	451	
11	13	21	45	38		326	424	431	522	562	
12	14	19	3	54		311	412	424	432	451	
13	19	41	59	7		231	311	411	511	532	
14	21	45	54	4		311	326	431	435	562	
15	21	41	44	59		231	311	326	424	522	
16	27	59	11	3		231	326	424	436	532	
17	31	3	63	8		412	432	435	436	441	
18	34	45	46	59		311	326	436	445	512	
19	38	45	21	13		326	424	431	522	562	
20	38	54	3	63		326	412	424	431	436	
21	44	19	59	41		221	231	311	424	511	
22	47	27	3	59		231	326	411	436	532	
23	47	63	45	54		326	411	431	435	436	
24	48	19	63	3		412	424	432	441	451	
25	61	41	27	3		231	326	411	532	573	
26	69	63	3	8		412	435	436	441	451	

Identification of Clusters by Factor Analysis

In an effort to prove or disprove the basic conclusion in the previous section, the inverse factor analysis technique was attempted on the perception data. The technique is the same as described in Chapter VI, with input being a 0-1 perception vector of 80 components, where the i^{th} component of the vector is 0 or 1 depending upon whether or not the participant (whose vector it is) has not or has perceived the i^{th} need. The algorithm then calculates a correlation matrix for the 69 participants and then determines a set of factors which are of fewer dimensions than the original 69, but which can reproduce the original correlation matrix. These factors are then rotated to determine a set of independent, orthogonal factors. The relationship of the original participants perception vector to the hypothetical factor vector is measured by the correlation between the two, termed the factor loading. For the analysis at hand, participants highly correlated with the same factor would be considered members of the same cluster. Using the available library factor analysis program (27) an initial solution was obtained which limited the number of factors in the initial solution to a number equal to the number of eigenvalues of the correlation matrix which are greater than zero. The number of rotated factors was then reduced by supplying a limiting value to the program which permits rotation of only those initial solution factors having at least one loading greater than the limiting value.

The initial solution of the 69 perception vectors of 80 components each, lead to a set of 69 factors. Using a limiting value of 0.441 reduced this set to three which were then rotated by the Varimax routine. Table 20 gives the final factor loadings that exceeded ±0.38 which is

Table 20 Factor Loadings - Three Factor Solution - Individual Perceptions

PART. NO.	FACTOR I	FACTOR II	FACTOR III
1			
2	.50		
3	.40	.57	
4			
5			
6			
7	.40		.44
8		.56	
9			
10			.72
11	.46		.49
12			.39
13	.48		
14		.44	
15			
16			
17			
18	.41		
19		.52	.45
20			
21	.45		.45
22			
23			

PART. NO.	FACTOR I	FACTOR II	FACTOR III
24			
25			
26			
27	.66		
28	.50		
29			
30			
31		.38	
32		.51	
33	.41		
34	.40		
35			.48
36			
37			
38			
39			.42
40			
41	.61		
42			.48
43			
44			
45	.50		
46	.46		

PART. NO.	FACTOR I	FACTOR II	FACTOR III
47	.41		
48		.55	.47
49			
50			
51			
52			
53		.41	
54	.42	.54	
55			
56			.71
57			.41
58			
59	.56		
60	.38		
61	.43		
62			
63		.66	
64		.44	
65	.56		
66		.39	
67			
68			
69		.63	

equivalent to the 5% significance level using the approximate standard error of factor coefficients as provided by Harman (29).

The clusters identified by this factor analysis have the following memberships:

Cluster	Members
$I_{.05}$	{2, 3, 7, 11, 13, 18, 21, 26, 28, 33, 34, 51, 45, 46, 47, 54, 59, 60, 61, 65}
$II_{.05}$	{3, 8, 14, 19, 31, 32, 48, 53, 54, 63, 64, 66, 69}
$III_{.05}$	{7, 10, 11, 12, 19, 21, 35, 39, 42, 48, 56, 57}
Unassigned	{1, 4, 5, 6, 9, 15, 16, 17, 20, 22, 23, 24, 25, 26, 29, 30, 36, 37, 38, 40, 43, 44, 49, 50, 51, 52, 55, 58, 62, 67, 68}

Because of the small number (3) of factors in the solution, 31 individuals were not significantly correlated with any of the factors and were therefore not assigned. It is also noted that several were correlated with more than one factor and therefore were placed in more than one cluster.

By the nature of the Varimax algorithm, the factors themselves are orthogonal and therefore uncorrelated in factor space. But for the results to be of value, the resulting clusters must, in turn, be uncorrelated in individual space. This was evaluated by use of the GRPCOR model described in Appendix 9; which provided the means of developing perception vectors for groups of participants and then examining the correlation among these group vectors. Two other sets of clusters were also identified for analysis in individual space. These were determined by restructing the memberships to participants whose perception vectors were more closely correlated with the hypothetical factor. For a 1% significance cutoff of 0.50, the clusters are:

Clusters	Members
$I_{.01}$	{2, 27, 28, 41, 45, 59, 65}
$II_{.01}$	{3, 8, 19, 32, 48, 54, 63, 69}
$III_{.01}$	{10, 56}

For the 0.1% level of significance, a cutoff of 0.60 was appropriate and resulted in the following clusters:

Cluster	Members
$I_{.001}$	{27, 41}
$II_{.001}$	{63, 69}
$III_{.001}$	{10, 56}

The first analysis was of the 0.1% level of significance clusters. These were the individuals whose perception vectors were most highly correlated with the hypothetical factor. The following correlation matrix significance matrices resulted:

Correlation

	$I_{.001}$	$II_{.001}$	$III_{.001}$
$I_{.001}$	1.00	.09	.06
$II_{.001}$		1.00	.09
$III_{.001}$			1.00

Significance

	$I_{.001}$	$II_{.001}$	$III_{.001}$
$I_{.001}$	.01	.00	.00
$II_{.001}$		.01	.00
$III_{.001}$			.01

The needs that are identified in common by each member of these clusters are as follows:

Cluster	Needs
$I_{.001}$	231, 326, 332, 335, 411, 424, 532, 562, 573
$II_{.001}$	412, 431, 435, 436, 441, 451, 574, 577
$III_{.001}$	231

The second analysis relaxed the degree to which individuals had to be correlated with the factor in order to be considered a member of the cluster. For a 1% level of significance, the ϕ correlation matrix for the clusters was

Correlation

	$I_{.01}$	$II_{.01}$	$III_{.01}$
$I_{.01}$	1.0	.20	-.02
$II_{.01}$		1.0	.3
$III_{.01}$			1.0

Significance

	$I_{.01}$	$II_{.01}$	$III_{.01}$
$I_{.01}$	.01	.05	.00
$II_{.01}$		.01	.00
$III_{.01}$			.01

The needs identified by 50% or more of the members of the cluster are:

Cluster	Needs
$I_{.01}$	311, 326, 329, 332, 335, 411, 424, 435, 436, 445, 511, 522, 532, 562
$II_{.01}$	221, 311, 411, 412, 424, 425, 431, 432, 435, 436, 441, 451
$III_{.01}$	231, 441

The final analysis was with the original cutoff of .38, which corresponds to the 5% level of significance for the factor loadings. The correlation and significance matrices resulting from the GRPCOR analysis are:

Correlation

	$I_{.05}$	$II_{.05}$	$III_{.05}$
$I_{.05}$	1.0	.35	.26
$II_{.05}$		1.0	.34
$III_{.05}$			1.0

Significance

	$I_{.05}$	$II_{.05}$	$III_{.05}$
$I_{.05}$	.01	.01	.01
$II_{.05}$		.01	.01
$III_{.05}$			.01

The needs identified by half or more of the members of the cluster are:

Cluster	Needs
$I_{.05}$	326, 411, 435, 436, 532, 562
$II_{.05}$	311, 412, 424, 432, 435, 436, 441, 451
$III_{.05}$	231, 424

The results here closely parallel the results obtained in the previous section. In that situation two clusters were identified. Cluster A was made up of members {3, 19, 54, 63} and had the common perception of 411, 412, 424, 431, 432, 436, and 451. Cluster B was made up of members {41, 45, 59}, with common perceptions of 311, 326, 329, 335, 411, 424, 511, 522, and 562. As the common perception constraint was relaxed, it became more and more difficult to define the two clusters. The result was that there appeared to be one large cluster surrounded by a number of individuals who did not closely match any of the members of the cluster. The same situation occurred with the results of the factor analysis, only in this case the third cluster was centered around a hypothetical factor that approached zero, for the highest loadings for this factor were for individuals 10 and 56 who had perceived only 1 and 2 needs respectively. The remainder of the participants fell into a limbo that resulted from their not being particularly correlated with any of the three factors. The following comparisons highlight the similarity of the results in terms of the needs that characterize the clusters from both the cluster analysis and the three levels of the INFAC analysis: (Note that the cluster results, A and B, are most closely matched with the 0.01 significance level INFAC results, $I_{.01}$ and $II_{.01}$)

Cluster	Needs
A	411, 412, 424, 431, 432, 436, 451
$II_{.001}$	412, 431, 435, 436, 441, 451, 574, 577

$II_{.01}$	221, 311, 411, 412, 424, 425, 431, 432, 435, 436, 441, 451
$II_{.05}$	311, 412, 424, 432, 435, 436, 441, 451
Cluster	Needs
B	311, 326, 329, 335, 411, 424, 511, 522, 562
$I_{.001}$	231, 326, 332, 335, 411, 424, 532, 562, 573
$I_{.01}$	311, 326, 329, 332, 335, 411, 424, 435, 436, 445, 511, 522, 532, 562
$I_{.05}$	326, 411, 435, 436, 532, 562

The evaluation of each of these clusters, in their various forms is relatively easy. The first cluster is certainly member oriented. Essentially all of the needs are aimed at improving, retaining or replacing members in the organization. The second set is more a technique oriented set of identifications, closely related to industrial engineering activities, staff activities in general, and technical training. The set of participants identified with the first cluster (A-II) apparently perceive the improvement needs of the organization in terms of improving the members that compose the organization. The participants associated with the second set of clusters (B-I) apparently see the greatest opportunity for improvement in the area of techniques for operating and managing the organization. The overlap between these two clusters is again obvious in both solutions.

With this analysis and reconciliation of techniques, it is logical to attempt a factor solution of more than three factors to determine if other meaningful clusters exist.

Thirteen Cluster Analysis

By changing the limiting value to 0.40, the number of factors rotated is limited to thirteen based upon the same initial solution as used in the previous section. The resulting factor loadings are shown in Table 21; using the same 5% significance level of ±0.38 to eliminate some loadings. This table indicates the following cluster memberships:

Cluster	Members
I	{2, 7, 33, 34, 41, 43, 45, 59}
II	{1, 14, 19, 32, 48, 63}
III	{10, 26, 56, 57}
IV	{3, 22, 23, 31, 40, 47, 63, 69}
V	{5, 36, 52, 55, 57, 64, 67}
VI	{2, 4, 11, 13, 20, 21, 38, 54, 65}
VII	{24, 27, 51, 58, 66}
VIII	{6, 28, 42, 50}
IX	{18, 60, 61}
X	{17, 30, 37}
XI	{9, 11, 27, 39, 68}
XII	{8, 15, 46}
XIII	{24, 25, 33, 53, 62, 69}
Unassigned	{12, 16, 29, 35, 44, 49}

Table 22 lists the needs which are emphasized by each group. The criteria for selecting these was that a need was listed for a cluster if half or more of the cluster members identified it or if the particular cluster was the only one to identify the need. The Table also identifies in particular those need perceptions which were common to all members, those in which the particular cluster was the only cluster having the 50% or greater identification, and those for which the clusters perception

Table 21 Factor Loadings - Thirteen Factor Solution - Individual Perceptions

PART.	FACTORS												
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
1		.43											
2	.47					-.43							
3				-.39									
4						-.62							
5					-.71								
6								-.65					
7	.47												
8												.41	
9											-.51		
10			.87										
11						-.38					-.46		
12													
13						-.77							
14		.68											
15												.49	
16													
17										.60			
18									-.62				
19		.69											
20						-.63							
21						-.53							
22				-.53									
23				-.41									
24							.47						-.46
25													-.55
26			.60										
27							.38				-.52		
28								-.59					
29													
30										.50			
31				-.44									
32		.45											
33	.45												-.55
34	.50												

Table 21 Factor Loadings - Thirteen Factor Solution - Individual Perceptions (Cont.)

	FACTORS												
PART.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
35													
36					-.57								
37										.69			
38						-.39							
39											-.43		
40				-.71									
41	.55												
42								-.47					
43	.77												
44													
45	.64												
46												.63	
47				-.55									
48		.71											
49													
50								-.63					
51							.49						
52					-.43								
53													-.69
54						-.45							
55					-.46								
56			.85										
57			.42		-.58								
58							.79						
59	.46												
60									-.76				
61									-.49				
62													-.42
63		.53		-.49									
64					-.42								
65						-.54							
66							.65						
67					-.47								
68											-.74		
69				-.52									-.44

Table 22 Needs Perceived by Clusters - Thirteen Factor Solution

CLUSTERS	NEEDS PERCEIVED BY CLUSTER	COMMON PERCEPTIONS	PERCEPTIONS ≥ 50%	UNIQUE PERCEPTIONS
I	311 326 329 332 335 411 511 512 522 562 566	311	511 512	566
II	221 411 412 424 425 431 432 436 441 451 515 532	424		515
III	231 441	231	231	
IV	411 435 436 574	435	574	
V	422 541 543 564 575		541 543	422 564 575
VI	323 326 424 431 435 562	326 562		323
VII	322 332 432 445 573	432		322
VIII	313 329 412 436 445 521 552 569	412	313	
IX	221 425 454 514 522 531			
IX	221 324 326 335 411 552 563 565 569	326 335 569	324 563 565	
X	221 425 454 514 522 531 542	522	531 542	454
XI	335 424 532 561 562	561	561	
XII	111 221 311 327 423 433 435 436 441 442 445 451 514 521 522 532 553 573	221 436 441 445 521	111 442	327 423 433
XIII	325 332 436 451	451		325

of the need was unique

The first three clusters correspond to the first three under the three factor solution. The rest of the clusters are associated with either, or both, of these first two clusters in varying degrees. This is demonstrated by the correlation and significance matrices given in Table 23. Examining this table, it is evident that clusters VII,VIII,IX are closely correlated with Cluster I while clusters XI,XII are equally correlated with each of the first two clusters. This result would also tend to support the conclusion of two basic clusters among the need perceptions of individuals in the study.

The remaining ten clusters can then be examined in light of their members and group perceptions. Several of the ten minor clusters are worthy of further comment. Cluster V members with the exception of one (#64) are all members of either the quality control or the quality assurance organizations. Their identifications concentrated on two quality control needs (#541, 543) and they were the only cluster to identify three other needs (#422, 564, 575) two of which (#422, 564) have direct quality control considerations.

Cluster IX is composed of inventory, purchasing and equipment and tooling managers. The needs identified emphasize materials management, operations research, R and D relations, manpower planning, make or buy analysis, vendor scheduling, inventory control and marketing studies. This is a definite inventory - purchasing orientation.

Cluster X is composed of industrial engineers. They emphasized the need for new approaches to incentives, Pert - CPM capability, and general quality control studies.

Table 23 Correlation Analysis - Thirteen Factor Solution Clusters

FACTORS	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
					Correlation Matrix								
I	1.00	.10	-.01	.23	.11	.23	.40	.32	.28	.02	.25	.25	.13
II		1.00	.12	.17	.20	.32	.15	.07	.04	.16	.25	.25	.25
III			1.00	.20	.14	.13	.00	.08	.15	-.05	.23	.17	.20
IV				1.00	.27	.40	.38	.31	.23	.12	.53	.18	.27
V					1.00	.17	.13	.10	.02	.01	.13	.15	.19
VI						1.00	.29	.31	.23	.06	.48	.23	.22
VII							1.00	.29	.27	.01	.51	.22	.25
VIII								1.00	.23	.25	.23	.15	.31
IX									1.00	.03	.27	.01	.12
X										1.00	-.05	.19	.10
XI											1.00	.06	.31
XII												1.00	.16
XIII													1.00

Table 23 Correlation Analysis - Thirteen Factor Solution Clusters (Cont.)

Significance Matrix

FACTORS	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
I		.00	.00	.05	.00	.05	.01	.01	.01	.00	.05	.05	.00
II			.00	.00	.05	.01	.00	.00	.00	.00	.05	.05	.05
III				.05	.00	.00	.00	.00	.00	.00	.05	.00	.05
IV					.01	.01	.01	.01	.05	.00	.01	.00	.01
V						.00	.00	.00	.00	.00	.00	.00	.05
VI							.01	.01	.05	.00	.01	.05	.05
VII								.01	.01	.00	.01	.05	.05
VIII									.05	.05	.05	.00	.01
IX										.00	.01	.00	.00
X											.00	.05	.00
XI												.00	.01
XII													.00
XIII													

Cluster VII is a group of staff managers, all of the needs emphasized relate to staff problems, training of staff members, coordination among staffs, staff technicians, equipment evaluation, etc.

Cluster XII has the highest internal agreement of any of the clusters. Two of the members are industrial engineers, the other is manager of maintenance and construction. They had five perceptions in common (#221, 436, 441, 445, 521). The overall scope of their perceptions is very broad with emphasis on member motivational problems.

This chapter has demonstrated that it is possible to identify clusters of individuals based upon similarities among their perceptions of improvement needs. In the example cases, it was possible to relate the needs perceived by the cluster to the types of individuals composing the cluster. The most obvious relationships among cluster members is one of function and one of background. (For example, the quality control cluster, V .) The next chapter will explore functional relationships further as part of the analysis of perceptions related to the structure of the organization. However the difficulty in identifying specific, well differentiated clusters is that there were a large number of individuals whose broad range of improvement need perceptions permitted them to relate to most of the clusters formed by other participants. The result is that the number of clusters is dependent upon the extent that overlap between clusters is permitted. The analysis has shown that one, two, three, and thirteen clusters are possible depending upon their overlap. By modifying the limiting value in the INFAC algorithm, addition solutions could be developed to satisfy any particular requirement.

CHAPTER VIII

ANALYSIS OF NEEDS PERCEIVED AS RELATED TO STRUCTURAL CHARACTERISTICS

There are two different structures to any organization. One is the formal structure as defined by titles, organization charts, and assignments. This structure is determined explicitly by the organization and may be designed around classical organization theory, more modern organization theory as influenced by recent behavioral science findings, or it may be designed without regard for any particular theory, strictly on desires of the specific top management group. The other type of structure in that one determined by the members themselves, the informal structure. This is designed around recognition of information sources, recognition of skills, friendships, or any number of other bases, all of which are based upon individual choice.

Identification of Structural Groups

In the organization under study three models of the formal structure were determined. The first of those models was the managerial level model. This considered the formal structure from the viewpoint of individuals making up the various strata of the organization. The second model was a functional model. As the previous model, it was determined from the formal organization chart. This model grouped individuals into functional groups, identical with the departmental lines of the organization. The last model was titled the project model and consisted of groups of individuals developed in response to question 7 of the questionnaire (Appendix 3) which asked the names of other members that the respondent shared work assignments or projectswith. Analysis of the responses to this question were evaluated by the methods outlined in Appendix 8, which formed groups based upon reachability.

The informal structure was estimated from responses to questions 4, 5, and 6 of the questionnaire which asked the respondent to identify which members he had informal contacts on the basis of his own choice. The four models of the organization developed here are titled Social, Discussion, Advice, and Choice. The first three correspond to the three questions which asked for contacts of the nature indicated by the titles. The fourth was the composite of the three individual models. Evaluation of responses and development of the models were also in the manner of the Reachability Model developed in Appendix 8.

Formal Structures

Organizational Level Groups

The analysis of groups of individuals by organizational level is identical with the analysis of classes in the characteristic of managerial level found in Chapter VI. There it was determined that the first level of management perceived the improvement needs of the organization considerably different in comparison to higher level managers. The analysis in that chapter was centered around the zero-one vector of group perceptions which reflected the expected results of the particular set of individuals working together as a group. In this section, the emphasis of the perception of different levels can be considered by examining the average perception vector for the levels.

The following list gives the needs by level that were identified by half or more of the participants at that level. For the top level, as previously done, Part. Nos. 3 and 19 are combined; in this case their common perceptions are noted in the list.

Level	Emphasized Perceptions
1	none
2	335
3	451
4	326, 436, 522, 562
5	221, 231, 326, 411, 424, 431, 435, 436, 532, 552, 565
6	231, 311, 329, 411, 412, 424, 431, 432, 436, 441, 451, 532

Certain points of emphasis can be recognized. In the bottom level for this study, there were no agreements by half of the members, which perhaps reflects a lack of cohesiveness or awareness in this level. Level 2 had one need that 6 out of the 10 members at this level identified, calling for better relations with R and D. There doesn't seem to be any obvious reason for this, other than the idea that these individuals might have had ideas suggested to their superiors that were turned down with a statement that R and D wouldn't permit it or wouldn't go along with the idea. It should also be noted that even though two out of the three participants with the most perceptions are in this group (8, 45), only four more needs are even agreed upon by only forty percent or 4 out of the 10 members of this level. They are 332, 412, 435, 436. The first, coordination among staff groups, may come from the same source as the previous need. But the other three are all the result of upward looking individuals, watching retirement and indicating training needs related to new technology.

Level 3 managers agree on only one need in emphasis, 451 which calls for a continuation of the Management Design activity. This would logically stem from the fact that this management development activity has to date only been carried down to the next higher level hence this individual are aware of it, are waiting for it, and therefore wish it to continue. As one of the activities strong points was delegation, perhaps some of the people at this level have seen some of the good benefits of this program. This level also has a continuation of this line of emphasis if needs perceived by 40 per cent of the members are examined; there is only one, 424, the need for a management development program. This certainly matches the first need discussed.

The next level, Level 4, emphasize techniques: OR, technical training, new incentive techniques, production control system. This might reflect the idea that these individuals are not quite so concerned with getting ahead as the next lower level. These individuals have reached the level of private offices and some of the related benefits, perhaps now they become more concerned with technical problems of the organization and performance of that portion of the organization for which they have responsibility.

Level 5 seems to have the greatest internal agreement on what needs are important. Four or more individuals perceived eight needs that emphasize their desire for more knowledge about the direction of the company, approaches to organizational manpower problems and specific technical problems. The two individuals in Level 6, one of which is actually in Level 7, share much the same emphasis, mainly planning, organizational design, and member problems, including training.

The different levels in the organization, while they are significantly different overall except in the case of Level 1, do differ in the needs that they emphasize. And for the most part these can be related to the levels in a meaningful manner.

Functional Groups

There are seven basic functional groups in this organization. They are, with their members:

Purchasing	{60, 29, 18, 6, 50}
Equipment and Tooling	{61, 32, 69, 58, 68, 66}
Industrial Engineering	{59, 41, 44, 46, 42, 17, 37, 21, 45, 30, 39, 63, 8, 64}
Production Engineering	{47, 27, 25, 48, 34, 22, 53, 33, 10, 43, 55, 56}
Maintenance and Construction	{15, 51, 62, 16, 13, 40, 26, 24}
Manufacturing	{3, 54, 2, 12, 9, 7, 28, 38, 1, 35, 14, 31, 11, 4, 49, 20, 3}

Examining the needs emphasized by the perception of individuals in these functions organization is accomplished by the same manner as previously, by examining those needs for the group which 50 per cent or more of the group members have perceived. Purchasing agreed on 326, 335, and 552. The first, identifying the need for Operations Research, would be tied to the groups responsibility for many of the inventories. The second, better relation with R and D, would reflect their interface with R and D in selecting purchase parts appropriate vendors, and in trying to reduce costs through purchasing items that might be satisfactory but might not appeal to the engineer in R and D. The last need, a formal make or buy analysis technique is of course closely tied to purchasing activity.

Equipment and Tooling as a group emphasized 432, 441, and 573. First is management training for staff personnel, last is an equipment evaluation technique but the second item really serves to identify a major problem in this group. The need emphasizes employee retention. This department is composed of tool engineers and tool makers, both of which quickly become expert in relatively narrow areas and cannot be readily replaced as perhaps an industrial engineer can. Therefore this group is concerned with retaining their experts, primarily because replacements are not available.

Industrial Engineering participants emphasized 221, 311, 326, 424, 436, 522. Apparently IE's want to know the direction of the company in order to guide their own activities, as indicated by the first need. They also identify that the structure of the organization should be reviewed and, specifically, an Operations Research-Systems Analysis function established. The two areas of member improvement are logically management development, and technical training. The call for new approaches to incentives is of course basic to the IE function. The whole set of emphasized needs here seems to be broad but fits the IE function very nicely at this company.

It is interesting that the Production Engineering group emphasized only one need, 332, calling for cooperation and coordination among staff organizations. This organization in itself composed of three different staff groups. Methods Engineering, Process Engineering, and Manufacturing Engineering, which may be some of the reason behind this emphasis. Out of these subgroups, Methods Engineering had the greatest internal agreement in a manner which parallels IE but with more concern for training and project control.

Maintenance and Construction is faced with maintaining production equipment, which is under the control of the line organization. As a result they see the need for technical training for line management (#435) as well as two Operational System needs (#571, 574) that deal directly with their activities of maintenance.

Quality Control stressed technical training for line management also, as well as the whole set of quality control oriented needs in the Operational System category (#541, 542, 543). Both this organization and the previous one show a strong orientation toward functional problems rather than more organization-wide needs.

The last functional group is Manufacturing which includes line management and production control management at both plants, in addition to the Acting Manager of Manufacturing. The group emphasized 326, 412, 431, 451, and 562. It is interesting that this non-technical group emphasized Operations Research (#326) to the same extent as did the IE group who seem to be sponsoring the idea. The Manufacturing group was also concerned with the retirement coming up as well as management training and continuation of the Management Design effort. All of these point to the line manager's main job, that of managing. He is not faced with dual managerial-technical roles as staff managers are. Therefore his way seems to be clear and he takes it. The Management Design (#451) identification is also significant because the manufacturing group has been the prime user of this program since its inception. The last need emphasized by this group is 562, the production control system need, certainly an appropriate one.

Examination of the correlation matrix for the functional groups indicates that both Purchasing and Quality Control are relatively uncorrelated with all other groups with the possible exception of Manufacturing. INFAC analysis of this matrix developed three factors with the Purchasing and Quality Control closely associated with one factor; Equipment and Tooling, and Maintenance and Construction with another. The third was composed of Industrial Engineering and Manufacturing. Production Engineering was associated with both of the last two factors, though not to the extent of the first groups mentioned. This result matches the previous results and is intuitively satisfying.

The preceding analyses indicate that the functional responsibilities of an individual apparently do have a meaningful influence upon what he perceives as improvement needs within the organization. The broad perceptions of some individuals in the study tended to obscure this relationship but by examining the needs from an emphasis standpoint rather than from a total perception standpoint highlights the differences between these groups.

<u>Project Groups</u>

The analysis of the responses to question 7 lead to the identification of three groups of individuals that were closely related in terms of joint work assignments. The groups are as follows:

I. {3, 15, 36, 59, 60}

II. {4, 7, 14, 16, 21, 23, 26, 28, 35, 43, 44, 48, 62, 65}

III. {5, 13, 31, 32, 34, 41, 42, 46, 51, 54, 63, 64, 66, 68}

The perceptions of these groups are highly correlated. The correlations among the average perception vectors for each group are as follows

	I	II	III
I	1.00	0.44	0.63
II		1.00	0.75
III			1.00

Any $r \geq .2565$ indicates significance at the 1% level using a one-tailed test, so the statement of high correlation is justified. Group I is a top management group, while Group II is composed of Plant 2 people, only 3 are not located at that plant, but are staff people with Plant 2 assignments. Group 3 is a mixed group of people, 5, with specific Plant 1 responsibilities and staff people, 9, with broader responsibilities.

None of the groups have any perceptions that were common to the whole group, that is, needs that were perceived by each and every group member. To identify the emphasis of the group perceptions those needs that were identified by 4 or more individuals can be reviewed. They are:

I. - 411, 424, 532

II. - 231, 311, 326, 412, 424, 425, 431, 432, 435, 436, 451, 511, 522, 562, 569

III. - 221, 441, 442, 445, 573, 574

These indicate that Group 2 emphasis is on planning, training, especially for line managers,(including lateral transfers), new incentive techniques and in desiring marketing-orientes studies. The latter is probably a result of the close connection between Plant 2 operation and finished goods inventories. Group 3 shows emphasis on personnel problems that relate to staff department problems in securing college trained personnel and maintenance and equipment oriented systems.

The results here show again the effect of the individual on the study, but also indicate that the group results are indicative of the make up of the groups.

Informal Structure

Social Groups

The first informal structure to be reviewed is that resulting from social contacts reported by the participants. These groups are:

I. {3, 19, 60}

II. {5, 23, 52, 65}

III. {9, 31, 48}

IV. {4, 62, 63}

The average perception vectors of the groups are correlated as follows:

	I	II	III	IV
I	1.00	0.11	0.40	0.44
II		1.00	0.11	0.00
III			1.00	0.47
IV				1.00

Groups I, III, IV are significantly intercorrelated (1% level of significance) while Group II is not significantly correlated with any of the groups even at the 5% level.

Examining the needs identified show considerable lack of agreement within the groups, even within the very small groups here, only two even have one perception common to all members. Group I member agree on need 411 (Manpower Planning), while Group IV members agree on 451 (Management Design). Relaxing the restriction slightly to those needs identified by two or more of the group members, the group perceptions are:

I. - 411, 553

II. - 422, 541, 543

III. - none

IV. - 451

The result is that activity group II can now be seen to reflect the quality control orientation of all its members. No other conclusions can be seen.

<u>Discussion Groups</u>

Analysis revealed 4 groups in response to the question asking who the respondent discussed his work and its problems with. They are:

I. -{3, 4, 5, 31, 41, 46, 54, 65}

II. -{25, 32, 36, 50, 60, 61, 66, 68}

III. -{21, 28, 35, 43, 48}

IV. -{13, 16, 63}

Group I would appear to be a production oriented group composed of middle Managers in Manufacturing, Production Control, Industrial Engineering, and Quality Control. Group II is a group of mostly staff managers. Group III is a team composed of line and staff managers having common concern for paint and porcelain problems. Group IV is composed of maintenance managers and an IE manager having maintenance projects.

The only perceptions common to all the members of a group are found in Group IV. They are Nos. 435, and 574. The first is technical training for line managers and the second is the need for a maintenance management system. Both relate to the group. The groups had the following needs that were identified by 50% or more of their members:

I - 311, 326, 411, 432, 435, 436, 451, 532, 542, 562

II - 313, 335, 411, 532

III - 231, 412, 435, 562

IV - 326, 424, 425, 431, 435, 436, 451, 522, 571, 573, 574

The groups are correlated with each other in the following manner:

	I	II	III	IV
I	1.00	0.43	0.67	0.47
II		1.00	0.25	0.23
III			1.00	0.39
IV				1.00

The results of reviewing the needs emphasized by these particular groups shows some relationship with the orientation of the group members though only in the case of Groups I and IV. However in a general sense, none of the groups is highly differentiated.

Advice Groups

Five advice groups were identified:

I -{3, 5, 25, 27, 32, 36, 43, 50, 54, 58, 60, 61, 65, 66, 68}

II -{24, 26, 51}

III -{5, 7, 44}

IV -{3, 4, 31, 54}

V -{5, 18, 36, 65}

Correlations among the groups are:

	I	II	III	IV	V
I	1.00	0.43	0.53	0.70	0.58
II		1.00	0.13	0.23	0.01
III			1.00	0.49	0.53
IV				1.00	0.42
V					1.00

Only three correlations, both with Group II, are not significant to at least the 1% level. The emphasized perception for each group are as follows: (Emphasis for Group I is identification by 1/3 of members, 1/2 the members for other Groups)

I - 326, 335, 411, 432, 435, 436, 445, 451, 532, 542, 573

II - 231, 326, 332, 432, 445, 573

III - 231, 311, 411, 451, 511

IV - 311, 321, 326, 411, 412, 424, 431, 432, 435, 436, 441, 451, 532, 542, 551, 562, 574

V - 123, 221, 326, 335, 411, 435, 511, 532, 541, 542, 543

Like in previous cases, the needs perceived reflect the members making up the groups but do not present any strong well differentiated groupings. The most homogeneous group, Group II, made up of the Plant Engineer and his two subordinate engineering managers, is the least correlated with the rest of the groups, as might be expected. But within the group, the members are correlated as follows:

	24	26	51
24	1.00	-.09	0.13
26		1.00	0.32
51			1.00

Only members 26 and 51 are significantly correlated at the 1% level; hence the group is not likely to demonstrate a high degree of common, three-way, agreement.

Choice Groups

The last informal structure considered in a composite of the previous three. The groups are:

I -{24, 26, 51, 62}

II -{13, 16, 25, 50, 63}

III -{3, 4, 5, 13, 18, 23, 25, 27, 29, 31, 36, 41, 46, 50, 52, 54, 60, 61, 64, 65}

IV -{3, 4, 5, 9, 31, 48, 54}

V -{19, 27, 32, 36, 58, 60, 61, 66, 68}

VI -{4, 18, 29, 31}

VII -{21, 28, 31, 43, 48}

The correlation matrix for these groups is:

	I	II	III	IV	V	VI	VII
I	1.00	0.37	0.32	0.24	0.40	0.16	0.24
II		1.00	0.59	0.46	0.46	0.30	0.48
III			1.0	0.76	0.76	0.63	0.08

	I	II	III	IV	V	VI	VII
IV				1.00	0.61	0.64	0.75
V					1.00	0.41	0.53
VI						1.00	0.62
VII							1.00

The needs that were perceived by a half or greater (3/10 for Group III) of the group members are as follows:

I - 231, 332, 445, 571

II - 531

III - 424, 541, 542, 569

IV - 431

V - None

VI - 321, 324, 425, 551

VII - None

The Group I emphasis could be expected from their Plant Engineering orientation; Group VI by their inventory control, production control orientation. But as in previous analyses there aren't any overriding sets of group identifications that could be used in isolating a group on the basis of its perceptions.

Results

The preceding analyses have shown that the formal organization has some affect upon the needs perceived by members of the organization. The informal structures did not. The only meaningful patterns of emphasis in the informal groups appeared to be a result of the functional location of the individuals. Again the overall results here seem to be based more upon the chance groupings of certain highly perceptive individuals rather than grouping of people with common ideas, or on the transference of ideas from individual to individual in an informal group.

CHAPTER IX

ANALYSIS OF THE EVALUATION PROCESS AND RESULTS

When presented with a list of the improvement needs, an organization is forced to make some preliminary evaluation of them. Usually this is the task of management to sort through these ideas and either discard or hold for further review each of the ideas or needs identified. In the present study this process was considered and a formal technique developed that would permit meaningful evaluation of the results. The scoring model, specifically described in Appendix 6, has been previously discussed. The results of the scoring process have also been discussed and used as the basis for previous analyses. In this chapter, the results of the evaluation process will be analyzed from the standpoint of how it was affected by the makeup of the evaluation team and how it might have been affected had it been carried out by one individual or a sub-group of the evaluation team.

Evaluation Team

The Evaluation Team consisted of eleven top managers in the manufacturing Division. These men were selected as being the individuals who had the most direct and significant effect upon decision making within the manufacturing organization. Table 24 provides some selected information related to these individuals and their participation in the earlier phases of the study. The mean value for these attributes is also given

Table 24 Evaluation Team Characteristics

PART. NO.		AGE	YEARS WITH COMPANY	MANAGERIAL LEVEL	ACHIEVEMENT INDEX
3	Acting Manager of Manufacturing	59	21	6	-1.8
7	General Superintendent - Plant 2	60	40	5	-3.0
15	Manager - Maintenance and Construction	48	19	5	-0.6
19	Vice President - Manufacturing	57	15	7	-0.4
27	Chief Methods Engineer	45	20	4	-1.0
36	Manager - Quality Control and Inspection	61	18	5	-3.2
47	Manager - Production Engineering	63	N. A.	5	-3.6
54	General Superintendent - Plant 1	48	26	5	-0.6
59	Manager - Industrial Engineering	46	18	5	-0.2
60	Director of Purchases	61	14	5	-3.2
61	Manager - Equipment and Tooling	55	24	5	-2.0
EVALUATION TEAM MEAN		54.82	21.50	5.18	-1.78
STUDY MEAN		42.97	17.45	3.25	-1.39

Table 24 Evaluation Team Characteristics (Cont.)

PART. NO.	CREATIVITY INDEGREE	CONTACT HOURS	NUMBER OF PERCEPTIONS	PERCEPTIONS PER HOUR	OPP. VAL. SCORE	IPI PER HOUR
3	11	3	20	6.7	149.49	49.83
7	7	2	10	5.0	76.05	38.03
15	9	3	19	6.3	142.49	47.05
19	9	3	20	6.7	150.34	50.11
27	16	3	16	5.3	118.08	39.36
36	8	3	15	5.0	111.38	37.13
47	7	3	15	5.0	108.33	36.11
54	6	2	14	7.0	104.27	52.14
59	6	3	26	8.8	194.96	64.99
60	4	3	11	3.7	80.11	26.70
61	8	3	14	4.7	105.07	35.02
	8.27	2.73	16.36	6.07	121.87	43.36
	4.18	1.51	10.82	7.65	80.78	57.18

for the group and the study as a whole.

One of the interesting items shown by Table 24 is that in each of the attributes shown, the evaluation team has a higher mean with the exception of two cases. Both of these are where a result per contact hour statistic has been calculated. In each of these cases, the evaluation team scored less than the study participants as a whole. This, of course, tends to imply that there is a point of diminishing returns when interviewing individuals for perception of improvement needs. While it is not documented in this study, it was obvious during the conduct of the study that participants, in later interviews, tended to repeat perceptions stated in their previous interviews.

Need Evaluation by the Team

As noted in Table 24, the Evaluation Team as a whole had a high number of perceptions per individual. However, it is of interest to look at the types of improvement the team, as a whole, felt were needed.

In Table 25, the number of perceptions given by the team is shown for each need. As a whole, the team identified fifty-seven of the eighty needs identified by the study participants in total, or 71 per cent. None of the items received uniform perception by all team members. Only one received ten out of eleven perceptions. This was the need for predicting skills and personnel requirements, possibly by a manpower planning technique, No. 411. Only one resulted in nine perceptions, No. 532, which related to product or new model change over planning and scheduling needs. None received eight perceptions and only six more (four with seven perceptions and two with six) were perceived by more than half of the team. In total then, half or greater of the team agreed on, or had common iden-

Table 25 Need Perceptions by Evaluation Team

Need	Number of Perceptions	Need	Number of Perceptions
111	4	425	1
121	0	431	6
122	0	432	5
123	3	433	0
124	1	434	0
211	2	435	6
221	5	436	7
222	1	441	4
231	7	442	2
311	5	443	2
312	0	444	1
313	2	445	3
321	0	451	4
322	0	452	0
323	0	453	1
324	1	454	0
325	0	511	3
326	7	512	2
327	0	513	0
328	3	514	1
329	3	515	1
331	0	521	3
332	2	522	1
333	1	531	4
334	1	532	9
335	4	533	1
411	10	541	1
412	4	542	3
421	0	543	3
422	0	551	1
423	1	552	4
424	7	553	3

Table 25 Need Perceptions by Evaluation Team (con't)

Need	Number of Perceptions
561	3
562	4
563	1
564	0
565	4
566	0
567	1
568	0
569	2
571	1
572	0
573	4
574	4
575	0
576	0
577	0

SUMMARY

No. of Perceptions	No. of Needs
11	0
10	1
9	1
8	0
7	4
6	2
5	3
4	11
3	10
2	7
1	18
0	23

tification of, only eight needs, or ten per cent.

These eight needs were:

231	Long Range Planning	Rank 20
326	Establish OR-Systems Analysis	Rank 74
411	Manpower planning	Rank 22.5
424	Management development	Rank 22.5
431	Management training-line	Rank 43
435	Technical training-line	Rank 73
436	Technical training-staff	Rank 48
532	New product introduction method	Rank 39

The rank of these items is also shown in the preceding list. This is the rank of the item in the group evaluation. It is of interest to note that only one out of this group is in the top twenty in terms of Opportunity Value, and even that is at the bottom of the top twenty. One is even in the bottom twenty in terms of rank. It can be hypothesized that this group has tended to identify needs that they feel are important because of the corresponding difficulty in satisfying. Perhaps, if they had been easier to satisfy and therefore yielded a higher OV score, the team would have instigated action in the past and not emphasized these particular needs in their perceptions.

On the twenty-three items that the team failed to identify, there does not appear to be any particular pattern. Five of the needs are in the top twenty, including number one, while nine are in the last twenty in terms of the ranking by OV. Looking at these another way, eleven are in the top half of the rankings, twelve are in the bottom half of the rankings, and they do not fall in any particular category.

Need Identification by Subgroups of the Team

The Evaluation Team carried out three activities which permit identification of subgroups of the team and subsequent comparison of the needs identified by each of these subgroups. The first of these is the need identification activity, the second is the factor ranking activity, and the third is the evaluation process itself. The third activity will be discussed in detail in a later section of this chapter, and the other two will be analyzed here. The improvement needs of the organization as identified by the individual members of the Evaluation Team are provided in Table 26.

Need Identification Subgroups

In the previous section, it was identified that very few of the needs had uniform or general identification by the evaluation team. This result would tend to imply that there might be clusters of team members that tend to have identified the improvement needs of the organization differently than the rest of the team members. This implication is strengthened by comparing the number of identified needs the team members have in common; this is shown in Table 27.

In this table, Part. No. 3 can be seen to have many common identifications with Part. 19, but neither have many in common with Part. 60. Table 28 shows the correlation matrix resulting from determining the phi correlation coefficients among the individuals and with the total identification set. The significance matrix is also given in the table and identifies the correlations that are significantly different from zero at both the 5% and 1% error levels. First, it is noted that none of the individual perception sets are significantly correlated with the total set of perceptions. Secondly, like Table 27 and its example, Part. No. 3 can be seen to be highly correlated with Part. No. 19 while Part. No. 60 can be seen to be not significantly correlated with either 3 or 19.

Table 26 Needs Perceived by Evaluation Team Members

Group	Needs 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	231	311	326	329	411	412	424	431	432	435	436	441	451	532	542	551	553	571	573	574						
2	231	311	411	412	431	451	511	532	561	562																
3	111	123	221	313	423	424	435	436	441	442	443	445	514	521	532	543	565	573	574							
4	111	211	221	222	231	311	329	411	412	424	425	431	432	436	441	451	511	515	521	532						
5	231	326	328	332	335	411	424	432	435	436	445	531	532	561	562	573										
6	111	123	211	221	411	424	431	432	435	453	521	532	541	542	543											
7	111	124	231	326	328	332	411	431	435	436	442	531	532	552	574											
8	311	326	411	412	424	431	432	435	436	444	451	542	562	565												
9	221	231	311	326	329	333	335	411	424	436	443	445	511	512	522	531	532	533	543	552	553	561	562	565	567	574
10	123	313	324	326	335	411	552	553	563	565	569															
11	221	231	326	328	334	335	411	441	512	531	532	552	569	573												

Table 27 Number of Common Perceptions

	EVALUATION TEAM MEMBERS										
	3	7	15	19	27	36	47	54	59	60	61
3		7	7	12	9	7	8	11	10	3	6
7			1	8	5	3	4	6	7	1	3
15				7	6	8	6	4	9	3	4
19					6	9	6	8	9	1	5
27						5	9	7	11	3	8
36							5	6	5	2	3
47								5	8	3	7
54									7	3	2
59										6	9
60											5
61											

Table 28 Correlation Analysis - Evaluation Team

Correlation Matrix

	EVALUATION TEAM MEMBERS											
	3	7	15	19	27	36	47	54	59	60	61	**All**
3	1.00	.39	.15	.47	.36	.24	.31	.57	.22	.02	.19	.06
7		1.00	-.12	.48	.28	.11	.21	.42	.30	-.04	.12	.04
15			1.00	.15	.16	.33	.18	.05	.18	.03	.05	.06
19				1.00	.14	.39	.17	.34	.15	-.15	.11	.06
27					1.00	.16	.48	.35	.39	.07	.43	.06
36						1.00	.18	.28	.01	-.01	.03	.05
47							1.00	.20	.21	.09	.37	.05
54								1.00	.17	.10	-.04	.05
59									1.00	.19	.31	.08
60										1.00	.29	.04
61											1.00	.05
All												1.00

Table 28 Correlation Analysis - Evaluation Team (Cont.)

Significance Matrix

	EVALUATION TEAM MEMBERS											
	3	7	15	19	27	36	47	54	59	60	61	All
3		.01	.00	.01	.01	.05	.01	.01	.05	.00	.05	.00
7			.00	.01	.01	.00	.05	.01	.01	.00	.00	.00
15				.00	.00	.01	.00	.00	.00	.00	.00	.00
19					.00	.01	.00	.01	.00	.00	.00	.00
27						.00	.01	.01	.01	.00	.01	.00
36							.00	.01	.00	.00	.00	.00
47								.05	.05	.00	.01	.00
54									.00	.00	.00	.00
59										.05	.01	.00
60											.01	.00
All												

The desired objective of the analysis applied to each of these tables is to identify the subgroups that have identified common needs. To accomplish this, a cluster analysis approach was attempted using the cluster methodology described in Appendix 11. The model used here selects individuals and builds clusters based on the number of agreements or common identifications among individuals. Three parameters are used in this construction:

1. Maximum number of group members
2. Minimum agreement to start a group
3. Minimum agreement to add an individual to an existing group.

The decision rules of the model direct it to maximize the number of common identifications at each stage of the construction. The technique resulted in the identification of five groups when performed with a limitation that to add a person to a group, he must have identified at least 5 of the same needs as the existing group has in common. These results are shown in Table 29 where the group membership is given as well as the joint identifications.

In analyzing the correlation matrix of the Evaluation Team, the inverse factor analysis (INFAC) technique was used. With the INFAC approach, as described in more detail in previous chapters, the algorithm was used to select groups of team members in such a manner that group membership is identified by significant factor loadings in the analysis. Members were assigned to a particular group if their loadings exceeded .58, which is equivalent to a 5% significance level calculated by the method presented in Harman (29). The results of this analysis are shown in Table 30, in the same format as for the previous analysis.

Table 29 Subgroups in Evaluation Team - Cluster Analysis

SUBGROUP	1	2	3	4	5
MEMBERS	3	15	47	7	60
	19	36	61	54	
	27				
	59				
COMMON	231	111	231	311	123
IDENT.	411	123	326	411	313
NEEDS	424	221	328	412	324
	436	424	411	431	326
	532	435	531	451	335
		521	532	562	411
		532	552		552
		543			553
					563
					565
					569

Table 30 Subgroups in Evaluation Team - INFAC Analysis

SUBGROUP	1	2	3	4
MEMBERS	3	27	15	60
	7	47	36	
	19	59		
	54	61		
COMMON	311	231	111	123
IDENT.	411	326	123	313
NEEDS	412	328	221	324
	431	411	424	326
	451	531	435	335
		532	521	411
			532	552
			543	553
				563
				565
				569

Because of the larger subgroups resulting from the second approach, and the fact that there are only two duplications of common perceptions between subgroups in this analysis as opposed to seven for the first approach (excluding the one-member subgroups), the INFAC Analysis results, as shown in Figure 30, only will be considered. The first subgroup are homogeneous in at least one respect; they are the line management of the organization, the Vice President (No. 19), the Manager of Manufacturing (No. 3) and the two General Superintendents (Nos. 7, 54). From the perceptions they have in common, the subgroup is apparently concerned with the structure of the organization, staffing requirements and improvement in use of management techniques.

The next subgroup are three staff managers and the designated replacement for one of them who is due to retire shortly. As a group they see the needs for long-range planning, establishment of new functions (Operations Research and Manufacturing Research), manpower planning, and project planning skills.

The last subgroup is composed of two staff managers having maintenance (No. 15) and Quality Control (No. 36) responsibilities. They identify the need for growth and specifically identify expansion of the product line as the direction to go. Related to this, they felt that a statement of company objectives was needed. The member needs identified are directed toward management development and technical training for line personnel, of which both perceptions might be a result of the fact that both of these staff managers have many unit employees in their organizations. Their perception of the need for behaviorial science studies relates to this same characteristic. The remaining identifications are in terms of product introduction or change over planning and development of cost-quality trade-off techniques.

The general orientation of these subgroups seems reasonable in respect to the member's functional responsibilities. The first group being line management are less concerned with technical skills than they are with the managerial skills of the people in the organization. The second subgroup, staff managers, takes a stronger interest in planning and developing new problem solving techniques. The third subgroup shows a concern for company direction, in training and developing people, as well as solving particular problems. But because there are only two members to the group, it is more difficult to identify a general pattern of agreement. For much the same reason, there is no particular value in discussing the perception of Part. No. 60, who is not closely associated with any subgroup.

Factor Ranking Subgroups

The other activity which the team participated in that permits the development of subgroups is the task of factor ranking. The rankings, given in Table 4, were analyzed and found to be in general agreement as previously described (Chapter IV). The Spearman Rank Correlation Coefficients were calculated previously also, and are shown as Table 5. Using the significance test given in DuBois (23), it can be shown that several of the correlations between rankings are significantly different from zero at the .01 level. The relationships among the whole team, in terms of the 1% significant correlations is shown as a graph in Figure 16, where the lines indicate two rankings that are significantly correlated.

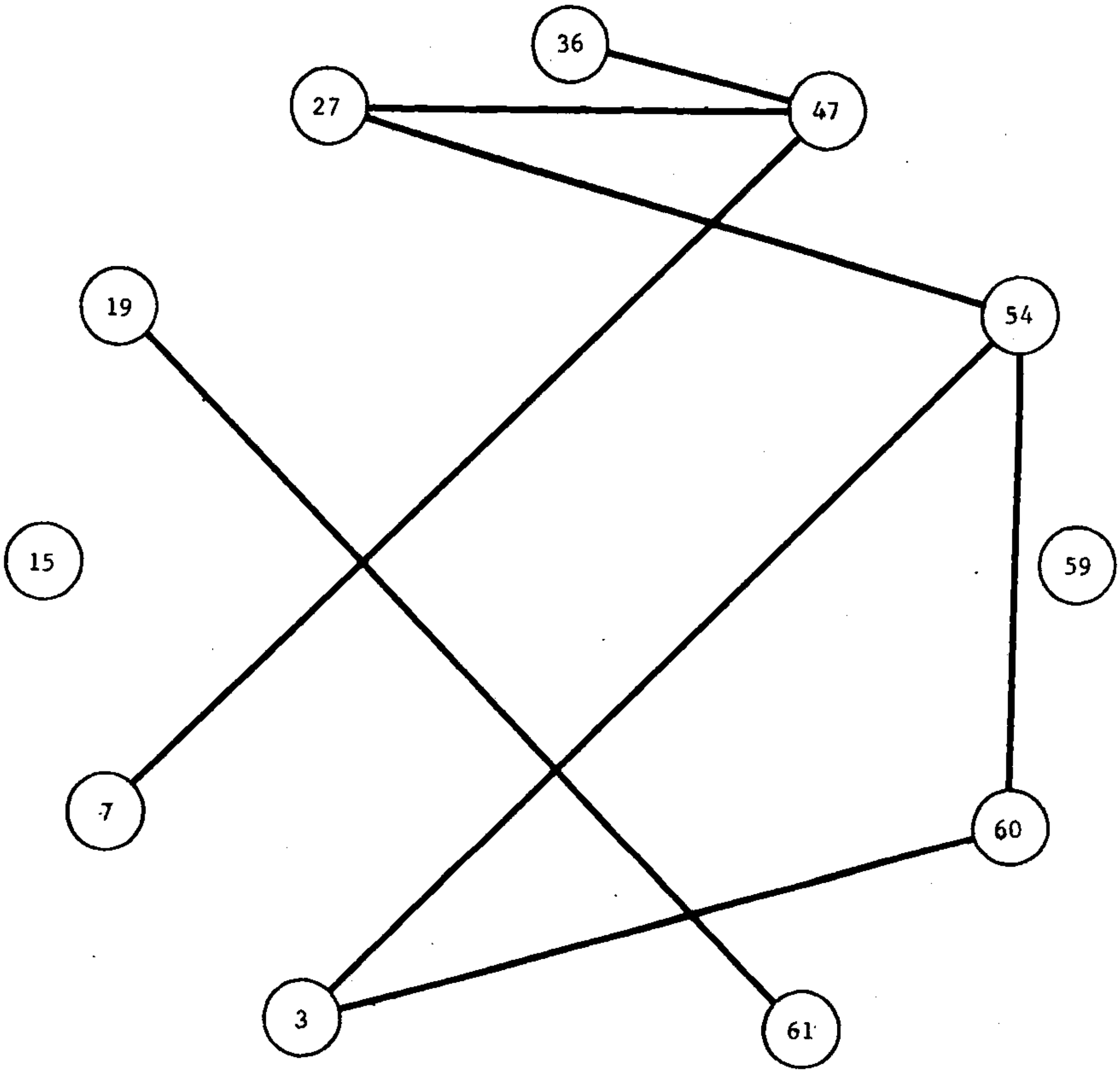


Figure 16 Graph of Significantly Correlated Rankings (.01 Level)

Analysis of the correlation matrix is accomplished using the INFAC routine. Initial analysis yielded the following subgroups.

Subgroup	Members
1	{3, 54, 60}
2	{19, 61}
3	{27, 36, 47}
4	{7}
5	{15}
6	{59}

Because of the number of single member subgroups, the INFAC analysis was repeated with reduced dimensionality and the following groups resulted:

Subgroup	Members
1	{3, 15, 54, 60}
2	{19, 59, 61}
3	{7, 27, 36, 47}

The three subgroups can be analyzed in terms of their common perceptions. The first has no needs that were perceived by all members; the second has four (#221, 231, 411, 532); the third has two (#411, 532), which is considerably different in number from the common identification for the subgroups in Table 30.

If the phi coefficients are calculated for the three subgroups, they turn out to be highly correlated (5% level of significance, one-tailed test = .2830) and therefore the assumption can be made that they are not greatly different in their total need identification. The correlation coefficients among the subgroups are:

	1	2	3
1	1.00	0.35	0.43
2		1.00	0.43.
3			1.00

The resulting conclusion is that the groups formed by similar preference rankings of factors had no relationship to the groups formed in terms of what needs they as individuals perceived.

Analysis of Need Ranking by Team Members

An important question is, if the evaluation process had been carried out by an individual, would the results be different from the results when the whole team carried out the ranking of factors and rating of needs? And, if there is a difference, it would be of interest to assign causes or probable reasons for the difference.

In the approach used in this study, each Evaluation Team member ranked the factors and then rated each need in terms of factors. As a consequence, the data from the process can be used to calculate a set of Opportunity Values for each need based upon the individual's particular evaluation. This will be identified as the Individual Opportunity Value set or IOV for convenience. The matrix of IOV's for all eleven team members is given in Table 31. Each column represents the results of a specific individual's evaluation process, with the last column giving the comparable results generated when the team worked as a whole. The correlation matrix for the IOV is given in Table 32, with the last column being the correlation of the individuals with the composite OV.

Preliminary evaluation of this correlation table is shown in Table 33 which is the significance matrix resulting from the standard

Table 31 Individual Opportunity Values

NEEDS	EVALUATION TEAM MEMBERS 3	7	15	19	27	36	47	54	59	60	61	Comp.
111	705.5	701.8	752.7	858.2	756.4	767.3	749.1	720.0	858.2	756.4	698.2	785.5
121	614.5	741.8	727.2	589.1	640.0	50.9	741.8	723.6	650.9	796.3	778.2	687.3
122	654.5	327.3	192.7	421.8	494.6	101.8	258.2	574.5	218.2	501.8	549.1	432.4
123	581.8	690.9	792.7	680.0	763.6	698.2	734.6	618.2	734.6	730.9	694.5	709.1
124	367.3	421.8	301.8	520.0	578.2	694.5	661.8	370.9	498.2	709.1	516.4	490.9
211	800.0	760.0	890.9	615.5	854.5	796.4	789.1	836.4	534.5	640.0	716.4	743.6
221	843.6	807.3	916.4	665.5	865.4	752.7	814.6	905.5	880.0	581.8	738.2	845.5
222	905.4	810.9	858.2	665.5	869.1	705.5	756.4	807.3	698.2	658.2	610.9	781.8
231	901.8	803.6	861.8	727.3	843.6	861.8	705.5	829.1	825.5	589.1	705.4	781.8
311	672.7	872.7	625.5	785.5	807.3	752.7	767.3	730.9	647.3	705.5	647.3	703.6
312	821.8	854.5	741.8	712.7	610.9	658.2	712.7	603.6	763.6	754.6	687.3	636.4
313	927.3	712.7	887.3	752.7	854.4	712.7	760.0	745.4	705.4	581.8	814.6	790.9
321	640.0	545.4	414.5	563.6	323.6	592.7	458.2	541.8	778.2	589.1	625.4	532.7
322	494.6	585.4	432.7	549.1	305.4	494.5	381.8	472.7	654.5	709.1	567.3	523.6
323	872.7	872.7	105.5	476.4	494.6	512.7	476.3	650.9	683.6	756.4	690.9	629.1
324	872.7	723.6	501.8	567.3	461.8	661.8	596.4	676.4	770.9	552.7	654.5	627.3
325	836.4	770.9	541.8	621.8	600.0	690.9	647.3	701.8	454.5	418.2	781.8	636.6
326	749.1	534.5	232.7	592.7	578.2	574.6	672.7	600.0	803.6	603.6	636.4	618.2
327	556.4	585.4	501.8	450.9	403.6	578.2	592.7	625.5	629.1	305.4	549.1	523.6
328	770.9	734.5	610.9	578.2	636.4	716.4	687.3	669.1	690.9	610.9	560.0	636.4
329	821.8	770.9	723.6	738.2	741.8	701.8	854.5	916.4	832.7	520.0	807.3	800.0
331	814.5	865.4	898.2	843.6	778.2	716.4	785.4	840.0	734.5	676.4	952.7	823.6
332	792.7	796.4	905.4	829.1	770.9	883.6	814.5	829.1	734.5	680.0	975.5	809.1
333	792.7	810.9	898.2	829.1	770.9	876.4	785.4	847.3	770.9	694.5	974.5	823.6
334	868.2	880.0	890.9	865.5	814.5	854.5	752.7	774.5	803.6	578.2	865.4	803.6
335	683.6	745.5	880.0	865.5	814.5	865.5	800.0	869.1	865.4	610.9	829.1	794.5
411	832.7	810.9	720.0	770.9	836.4	745.5	712.7	785.5	792.7	643.6	756.4	780.0
412	865.5	898.3	883.6	770.9	898.2	836.4	901.8	778.2	880.0	865.5	683.6	827.3
421	789.1	890.9	854.5	915.4	694.5	876.4	760.0	763.6	781.8	770.9	832.7	800.0
422	836.4	672.7	680.0	847.3	683.6	730.9	720.0	665.5	690.9	778.2	861.8	754.5
423	792.7	872.7	752.7	789.1	741.8	854.5	810.9	756.4	535.5	727.3	832.7	745.5
424	749.1	854.5	803.6	810.9	760.0	818.2	676.4	843.6	734.5	745.5	840.0	780.0

Table 31 Individual Opportunity Values (Cont.)

NEEDS	EVALUATION TEAM MEMBERS 3	7	15	19	27	36	47	54	59	60	61	Comp.
425	763.6	625.4	527.3	770.9	712.7	814.5	738.2	600.0	589.1	727.3	603.6	654.5
431	770.9	781.8	792.7	774.5	665.4	749.1	770.9	741.8	720.0	716.4	792.7	749.1
432	770.9	847.3	789.1	807.3	701.8	727.3	752.7	774.5	720.0	734.5	778.2	790.9
433	781.8	836.4	690.9	763.6	756.4	712.7	672.7	589.1	763.6	698.2	661.8	718.2
434	781.8	865.4	720.0	736.6	749.1	716.4	727.3	614.5	727.3	723.6	727.3	730.9
435	760.0	647.3	592.7	676.4	712.7	760.0	516.4	585.5	658.2	730.9	727.3	621.8
436	752.7	730.9	658.2	730.9	752.7	749.1	640.0	694.5	720.0	749.1	749.1	740.0
441	807.3	814.5	840.0	763.6	785.5	810.9	781.8	672.7	800.0	610.9	894.5	761.8
442	869.1	894.5	869.1	745.5	778.2	767.3	720.0	807.2	741.8	432.7	887.2	770.9
443	789.1	930.9	836.4	730.9	785.5	778.2	727.3	785.4	629.1	432.7	749.1	752.7
444	807.3	818.2	680.0	683.6	770.9	614.5	789.1	752.7	647.3	760.0	661.8	703.6
445	807.3	872.7	694.5	683.6	720.0	592.7	760.0	683.6	647.3	743.5	698.2	740.0
451	898.2	949.1	894.5	810.9	785.4	912.7	949.1	701.8	869.1	458.2	607.3	823.6
452	880.0	825.5	894.5	629.1	774.5	843.6	840.0	712.7	476.3	530.9	890.9	767.3
453	825.4	985.4	821.8	672.7	629.1	869.1	730.9	818.2	636.3	476.4	989.1	767.3
454	890.9	949.1	785.5	738.2	723.6	792.7	760.0	720.0	607.3	545.5	989.1	767.3
511	807.3	901.8	709.1	796.4	643.6	872.7	774.5	712.7	807.3	523.6	669.1	721.8
512	825.5	829.1	767.3	763.6	843.6	745.5	745.4	792.7	792.7	578.2	836.4	772.7
513	850.9	843.6	883.6	756.4	843.6	865.5	872.7	756.4	687.3	632.7	872.7	790.9
514	861.8	785.5	774.5	854.6	738.2	836.4	821.8	723.6	683.6	585.5	825.5	776.4
515	781.8	865.4	614.6	425.4	629.1	352.7	450.9	618.2	403.6	465.5	338.2	554.5
521	800.0	738.2	589.1	665.5	469.1	836.4	647.3	716.4	581.8	563.6	629.1	654.5
522	716.3	680.0	694.6	803.6	574.5	901.8	730.9	749.1	741.8	534.5	774.5	680.0
531	850.9	800.0	803.6	738.2	916.4	800.0	825.5	650.9	680.0	665.5	632.7	749.1
532	832.7	949.1	687.3	701.8	945.4	756.4	854.5	614.5	661.8	560.0	690.9	754.5
533	803.6	920.0	552.7	676.4	850.9	785.5	803.6	647.3	760.0	618.2	909.1	781.8
541	825.4	850.9	810.9	723.6	752.7	774.5	745.4	665.4	705.4	581.8	643.6	703.6
542	850.9	850.9	803.6	847.3	687.3	756.4	781.8	720.0	752.7	621.8	749.1	730.9
543	825.4	912.7	640.0	661.8	643.6	821.8	654.5	723.6	723.6	672.7	632.7	721.8
551	894.5	912.7	698.2	665.5	676.4	880.0	727.3	727.3	789.1	767.3	614.5	763.6
552	829.1	930.9	745.4	614.5	909.1	836.4	741.8	709.1	736.6	778.2	712.7	790.9

Table 31 Individual Opportunity Values (Cont.)

NEEDS	EVALUATION TEAM MEMBERS 3	7	15	19	27	36	47	54	59	60	61	Comp.
553	796.3	796.4	447.3	509.1	505.4	640.0	665.4	658.2	720.0	603.6	774.5	660.0
561	800.0	570.9	643.6	680.0	596.4	785.5	796.4	621.8	760.0	545.5	876.4	700.0
562	876.4	810.9	792.7	701.8	701.8	792.7	774.5	785.5	778.2	661.8	854.5	763.6
563	854.5	843.6	749.1	701.8	676.4	829.1	712.7	741.8	680.0	669.1	803.6	776.4
564	963.6	720.0	643.6	770.9	720.0	774.6	821.8	778.2	690.9	789.1	840.0	789.1
565	800.0	894.5	687.3	800.0	683.6	810.9	847.3	760.0	752.7	810.9	767.3	794.5
566	614.5	665.4	18.2	872.7	530.9	792.7	829.1	720.0	680.0	763.6	803.6	758.2
567	756.3	749.1	643.6	676.4	661.8	589.1	807.3	669.1	640.0	549.1	989.1	690.9
568	752.7	749.1	760.0	749.1	749.1	981.8	785.5	752.7	603.6	618.2	814.6	740.0
569	683.6	865.5	749.1	545.5	676.4	690.9	629.1	640.0	669.1	400.0	836.4	669.1
571	792.7	920.0	945.4	687.3	807.3	523.6	898.2	818.2	650.9	476.4	665.5	758.2
572	905.4	949.1	941.8	923.6	836.2	974.5	869.1	680.0	698.2	738.2	807.3	900.0
573	876.4	890.9	847.3	760.0	723.6	680.0	654.5	734.5	654.5	614.5	665.5	749.1
574	774.5	818.2	796.4	618.2	763.6	847.3	789.1	741.8	778.2	640.0	825.5	754.5
575	887.3	949.1	850.9	778.2	847.3	843.6	847.3	818.2	738.2	636.4	890.9	776.4
576	810.9	596.3	614.5	603.6	458.2	712.7	803.6	650.9	665.5	643.6	880.0	663.6
577	810.9	963.6	760.0	774.5	745.4	640.0	785.5	858.2	672.7	643.6	773.3	767.3
Mean	791.1	795.3	706.7	710.9	707.2	739.7	733.4	714.6	699.5	633.5	751.6	734.6
Std. Dev.	96.9	124.5	186.7	110.7	130.7	153.1	114.8	93.9	108.0	108.9	123.5	81.6

Table 32 Correlation Matrix - Individual Opportunity Values

	EVALUATION TEAM MEMBERS											
	3	7	15	19	27	36	47	54	59	60	61	Comp.
3	1.00	.60	.48	.33	.47	.39	.40	.51	.25	-.03	.31	.62
7		1.00	.59	.40	.56	.40	.49	.51	.30	.01	.26	.68
15			1.00	.53	.70	.46	.59	.61	.33	-.05	.38	.72
19				1.00	.51	.63	.64	.49	.47	.33	.48	.76
27					1.00	.42	.64	.51	.27	.17	.26	.75
36						1.00	.57	.34	.45	.10	.41	.63
47							1.00	.53	.43	.14	.47	.79
54								1.00	.33	-.01	.47	.74
59									1.00	.22	.24	.54
60										1.00	.04	.26
61											1.00	.57
Comp.												1.00

Table 33 Significance Matrix - Individual Opportunity Values

	EVALUATION TEAM MEMBERS											
	3	7	15	19	27	36	47	54	59	60	61	Comp.
3		.01	.01	.01	.01	.01	.01	.01	.05	.00	.01	.01
7			.01	.01	.01	.01	.01	.01	.01	.00	.05	.01
15				.01	.01	.01	.01	.01	.01	.00	.01	.01
19					.01	.01	.01	.01	.01	.01	.01	.01
27						.01	.01	.01	.01	.01	.00	.01
36							.01	.01	.01	.01	.00	.01
47								.01	.01	.00	.01	.01
54									.01	.00	.01	.01
59										.05	.05	.01
60											.00	.05
61												.01
Comp.												

test to determine if the correlation coefficient is significantly different from zero. In this case, it can be seen that there is a high degree of correlation among the IOV. Of particular interest in the high degree of correlation with the composite results; only one member, No. 60, falls into the 5% significance classification.

Another view of the correlation matrix is possible. It can be assumed that because of the source of the data, that is, team members with common goals and working in the same organization, that a high degree of agreement is expected. With this assumption, it is of interest to test the significance of the correlation coefficients in comparison to some population correlation coefficient, $\hat{r}$, not equal to zero, as it is for the tests implied in Table 33. The assumed population value $\hat{r}$ is taken as .64; this is the average of the individuals correlations with the composite. Using Fisher's z_r Transformation of r, as described in DuBois (23), a confidence interval around $\hat{r}$ = .64 can be developed using a unidirectional or one-tailed test which can be stated as follows:

$$\text{Conf.} \ (r \geq .516) = 0.95$$

The results of this test at the 5% level of significance are shown in Figure 17. In this Figure, the significant correlations are shown as arcs connecting the nodes representing the team members. On examining this graph, it can be seen that there is not any particular grouping of members illustrated except for the exclusion of Participant Nos. 59, 60, 61.

Another analysis of the correlation matrix was made using the inverse factor analysis technique, INFAC. The results were unsatisfactory from the viewpoint that the resulting groups or factors show loadings that

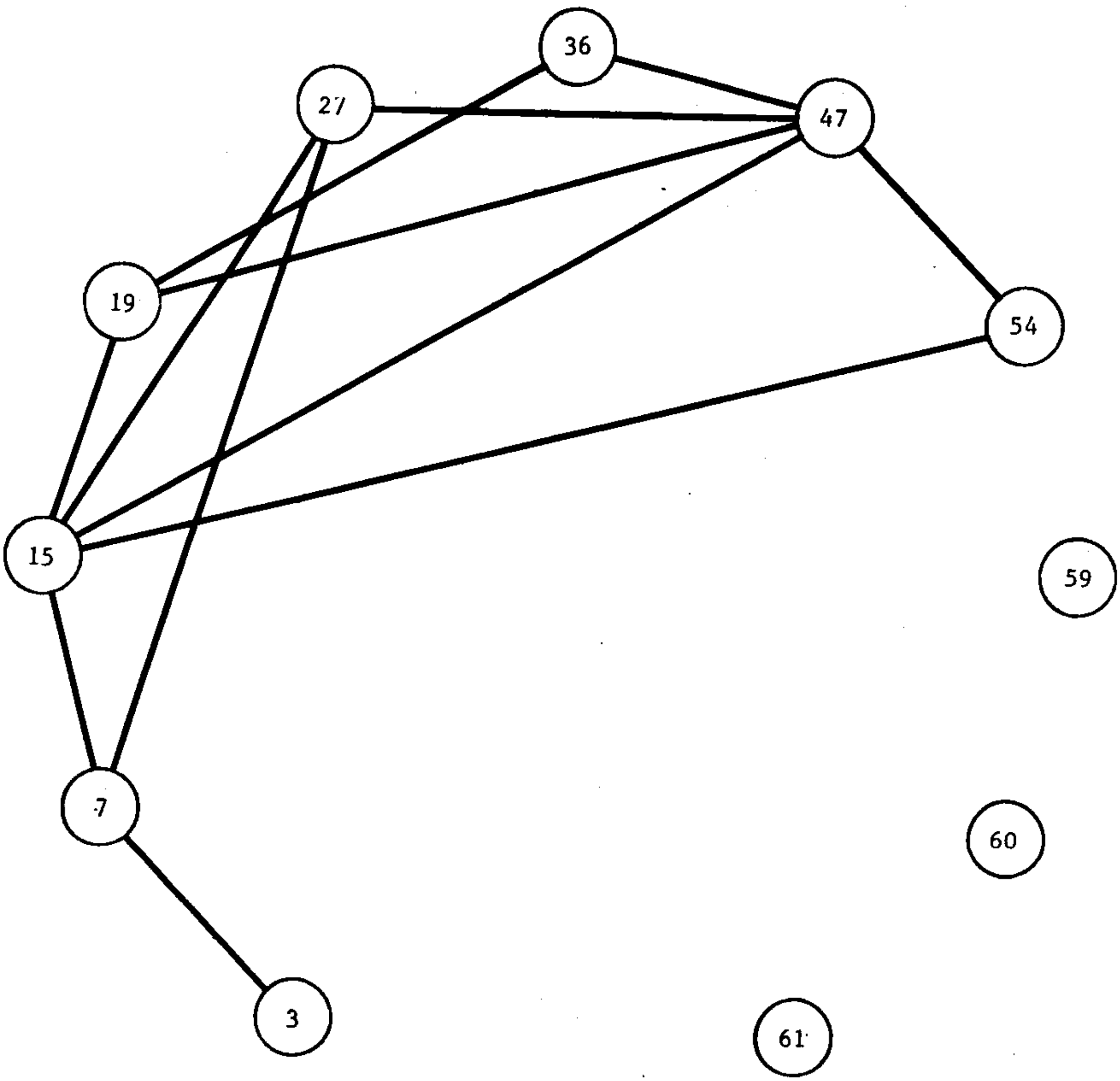


Figure 17 Graph of Correlated IOV for r = 0.64

indicate joint membership in subgroups or in other words, prevent the assignment of an individual to a unique group. A two factor solution with 5% significance level loadings are shown in Table 34. The resulting subgroups are:

Subgroup I = {3, 7, 15, 19, 27, 36, 47, 54, 61}

Subgroup II = {19, 36, 47, 59, 60, 61}

In an attempt to develop subgroups of smaller size, and more unique, a four factor solution was initiated. The results in terms of significance (5% level) factor loadings are shown in Table 35. Resulting subgroup members are:

Subgroup I = {3, 7, 15, 19, 27, 47, 54}

II = {19, 60}

III = {19, 47, 54, 61}

IV = {19, 36, 47, 59}

These groups can be reduced in size by changing the significance level to 1%, thereby restricting memberships to those IOV set more highly correlated with the hypothetical factor. The subgroups then become

Subgroup I = {3, 7, 15, 27, 47, 54}

II = {60}

III = {61}

IV = {36, 59}

This result compares favorably with that of Figure 17.

When the subgroups determined here are compared to the previous subgroups evaluated in this chapter, the only common characteristic is the exclusion of Part. No. 60 (see Table 30). This individual identified a set of needs that was considerably different from those his

Table 34 Factor Loadings - IOV Analysis - Two Factors

TEAM MEMBERS	FACTOR I	FACTOR II
3	-.75	
7	-.78	
15	-.82	
19	-.47	.74
27	-.71	
36	-.49	.55
47	-.64	.52
54	-.75	
59		.63
60		.74
61	-.47	.35

Table 35 Factor Loadings - IOV Analysis - Four Factors

TEAM MEMBERS	FACTOR I	FACTOR II	FACTOR III	FACTOR IV
3	-.74			
7	-.82			
15	-.75			
19	-.36	-.35	.48	-.51
27	-.80			
36				-.71
47	-.54		.45	-.40
54	-.66		.47	
59				-.86
60		-.95		
61			.90	

fellow team members identified and he evaluated the whole set of needs in such a manner that the results did not agree with the whole team.

The conclusion that can be reached at this point is that the evaluation technique used for developing the Opportunity Values resulted in a composite set of OV that were not unduly influenced by any individual or subgroup of team members carrying out the analysis.

Analysis of Need Ranking Extremes

The analysis carried out in the previous paragraphs supported the conclusion that the scoring model does develop an overall set of Opportunity Values that are an acceptable composite of the individual evaluations performed by the team members. This can be seen in the correlation matrix in Table 32, all the members are highly correlated with the composite. The correlation analysis and the INFAC analysis showed that there were no strong subgroups in this correlation matrix except for the partial exclusion Part. Nos. 59, 60, and 61.

These conclusions are supported if those needs that were scored at the top or bottom of the range by each individual are compared among individuals and with the composite. Tables 36 and 37 show the number of needs identified in common as being in the top ten or bottom ten, respectively, of the IOV sets among individuals and between individuals and the composite. In both tables, it can be seen that the individuals have more high or low ranking evaluations in common with the composite than they do among themselves which would indicate a good composite technique. And also in both tables, Part No. 60 can be seen as having among the lowest number of common evaluations, reflecting his differences from the rest of the team.

Table 36 Common Needs in Top Ten by IOV

	EVALUATION TEAM MEMBERS											
	3	7	15	19	27	36	47	54	59	60	61	Comp
3		4	3	1	1	3	3	1	2	2	2	2
7			3	1	2	3	4	1	1	1	3	2
15				3	2	4	4	5	3	0	3	7
19					0	2	1	2	3	3	1	4
27						0	2	2	2	3	1	2
36							2	2	2	2	3	5
47								1	3	2	0	4
54									4	0	3	5
59										1	0	5
60											0	2
61												3
Total Com.	22	23	30	17	15	23	22	21	21	14	16	41
Ave. Com.	2.2	2.3	3.0	1.7	1.5	2.3	2.2	2.1	2.1	1.4	1.6	3.7

Table 37 Common Needs in Bottom Ten by IOV

	EVALUATION TEAM MEMBERS											
	3	7	15	19	27	36	47	54	59	60	61	Comp.
3		5	6	5	5	5	4	4	2	2	4	5
7			6	5	5	5	5	7	3	2	5	7
15				8	8	6	6	5	2	2	4	8
19					7	6	8	4	3	4	5	8
27						5	6	3	2	2	3	6
36							6	4	2	4	4	7
47								4	2	4	4	8
54									3	1	4	6
59										3	4	3
60											4	3
61												5
Total Com.	42	48	53	55	46	47	49	39	26	28	41	66
Ave. Com.	4.2	4.8	5.3	5.5	4.6	4.7	4.9	3.9	2.6	2.8	4.1	6.0

The team members found more agreement on what needs did not represent opportunities than on which did constitute improvement opportunities. Table 36 shows that agreement among individuals ranged from an average of 1.4 items for Part. No. 60 to an average of 3.0 for Part. No. 15, with an average of 3.6 for agreement with the composite. If there had been perfect or complete agreement, these averages would have been 10. In Table 37, the low is an average of 2.6 and a high an average of 5.5. Again Part. No. 15 has the high value, while Part. No. 59 has the low value this time. The average in common with the composite is 6.0 compared to a maximum possible of 10.0. Of particular interest is how each of the individuals compares with the composite, that is, which need would the individual give priority to (as implied by a high IOV) that were not given the same status by the whole team? The same question can be asked concerning those needs given low proprity. For the purposes of this report this evaluation will be made by actually comparing both the top and bottom ten needs that the individual evaluated with the top and bottom ten that the whole team evaluated in terms of the composite.

The top ten for the composite are:

221 A specific statement of company objectives and philosophy

329 Establish an improvement function

331 Programs for improved coordination and cooperation among line organizations

332 Programs for improved coordination and cooperation between line and staff organizations

333 Programs for improved coordination and cooperation between line and staff organizations

334 Improved relations with Marketing

412 A plan for organizational change due to retirements in the future

421 A management selection program

451 Continuation and expansion of the Management Design activity

572 Safety standards

This set implies a concern with the problems of what direction the organization should be moving in and what activities might be undertaken to improve the ability of the organization to work together toward these goals. In addition, the specific problem of impending management turnover is identified. The specific problem of safety programs is also seen as being an opportunity.

The bottom ten are as follows:

122 Company growth through financing of consumer credit

124 Company growth through diversification of products into areas other than home appliances

321 Combine functions divided into P1 and P2 divisions. Example: Maintenance, Production Control, etc.

322 Establish a composite facilities responsibility. Example: plant security, fire production, maintenance, etc.

323 Combine Quality Control and Quality Assurance functions

324 Establish a Materials Management responsibility

326 Establish an Operations Research - Systems Analysis function

327 Study of OR applications outside manufacturing

435 Training in new technology for line personnel, all levels. Examples: OR, EDP, Manufacturing Technology, etc.

515 Evaluate of requirements for producing either or both high grade and low grade products on a given production facility.

The set shown here implies that the team felt that opportunities for the organization do not lie in the direction of consumer credit, diversification, or in producing low grade products. In addition, a considerable number of structure items are also of low improvement opportunity; including the establishment of an OR - Systems Analysis function. The specific technical training for all line managers was also felt to have a very low priority.

Table 38 gives the top and bottom ten evaluations for each individual as well as the composite. The table also identifies those needs that were evaluated in the common with the composite and those evaluations that were unique to the whole team (by one and two asterisks, respectively). This table can then be analyzed by individual to determine any assignable causes for difference and uniqueness.

Part. No. 3 Acting Manager of Manufacturing

This individual sees opportunity in developing objectives. knowing what skills and capabilities are available and then using this information to manage. He has had some planning responsibility for operational systems of an EDP nature and hence emphasizes the opportunities here. He was the only individual to evaluate the opportunity of product line expansion, revision of organization structure, and improving relations with R and D as low.

Part. No. 7 General Superintendent - Plant 2

This man emphasized the recruitment problems associated with

Table 38 Top and Bottom Ten IOV by Individual

	EVALUATION TEAM MEMBERS											
	3	7	15	19	27	36	47	54	59	60	61	Comp.
	222	443**	211	111	211	332*	329*	211	111	121**	331*	221
	231	451*	221*	331*	221*	333*	412*	221*	221*	412*	332*	329
	312**	453	331*	334*	222	421*	451*	231	231	421*	333*	331
	451*	454	332*	335	313**	451*	452	329*	326**	422	441**	332
TOP	452	532	333*	421*	412*	453	513**	331*	329*	444**	452	333
TEN	454	552	334*	422	531**	511	532	332*	334*	551	453	334
	551	571	451*	514**	532	522**	565	333*	335	552	454	412
	564	572*	452	542**	533	551	571	335	412*	564	533	421
	572*	575	571	566	552	568**	572*	424**	451*	565	567**	451
	575	577	572*	572*	575	572*	575	577	511	566	575	572

	EVALUATION TEAM MEMBERS											
	3	7	15	19	27	36	47	54	59	60	61	Comp.
	121	122*	122*	122*	122*	121	122*	122*	122*	122*	122*	122
	122*	124*	124*	124*	321*	122*	321*	124*	124*	325	124*	124
	123**	321*	321*	321*	322*	321*	322*	312**	211**	327*	222**	321
	124*	322*	322*	322*	323*	322*	323*	321*	325	442**	322*	322
BOTTOM	311**	326*	323*	323*	324*	323*	324*	322*	423**	443**	327*	323
TEN	321*	327*	324*	324*	327*	326*	327*	326*	425	451	328**	324
	322*	425	326*	327*	521	327*	435*	425	452**	453**	425	326
	327*	435*	327*	515*	553	515*	515*	433**	515*	515*	451	327
	335**	561**	553	553	566	567**	543**	435*	521	569	515*	435
	566	576	566	569	576	571	569	532**	568**	571	551**	515

(*=Common Evaluation with Composite) (**=Evaluation Unique among Team) experienced personnel and the need for techniques for measuring performance. He also identified several operational system opportunities that would be in line with his present responsibility for the company's largest production facility and his previous responsibility as Production Control Manager. On the bottom scale, he did not see much opportunity for a lateral transfer program nor a central dispatching system for material handling equipment. An unsatisfactory analysis of such a dispatching system had been made previously in his plant.

Part. No. 15 Manager - Maintenance and Construction

This individual alone had no unique evaluation in either the top or bottom ten. He also had the highest rate of agreement with his fellow team members. This is of particular interest when it is noted that his ranking of rating factors was significantly different from all the other team members at the 1% level and different from all but Part. No. 59 at the 5% level. A specific evaluation that can be traced to the area of this individual's responsibility is No. 571 covering standards for new equipment facilities.

Part. No. 19 Vice President - Manufacturing

The Vice President saw the need and associated opportunity for growth of the organization but ruled out consumer credit and diversification as being the means. His evaluation of the opportunity present for improving relations with R and D placed it in the top ten but on the other hand he saw little opportunity for applying Value Analysis techniques as there had been a situation in which Value Analysis had been blocked by R and D in the past, this appears as a consistency in his evaluation. His high evaluation of paperwork control, and quality control studies were unique evaluations among the team.

Part. No. 27 Chief Methods Engineer

Many of the items identified as having the most opportunity by this individual are related to his responsibility. He places high evaluations on project management need, space utilization, and formal make or buy decision techniques. He also stresses the need for improved direction for the organization and its subunits by giving high evaluation to needs that cover statements of objectives and responsibilities for all levels.

Part.No. 36 Manager Quality Control

This manager emphasized the need for performance measurement and new approaches to incentives, but not evaluate any of the quality control needs as having high or, for that matter, low in his analysis which might have been expected. He also gave high evaluation to assembly line balancing needs but low priority to use of simulation as a technique of doing the balancing.

Part. No. 47 Manager - Production Engineering

The top evaluations of this manager match his responsibilities to a large extent. He differs from the group in his high evaluation of the need for equipment utilization measurement and low evaluation of quality-cost tradeoff techniques.

Part. No. 54 General Superintendent - Plant 1

The General Superintendent of the original, but now smaller, production facility was unique in his high evaluation of the need for a management development program. This is understandable from a personal standpoint because he is in a position to take advantage of such a program if it were available. He also sees opportunity in satisfying the need for long range planning. He was unique in his low evaluation of the need for a new product or new model changeover planning and scheduling technique, perhaps because his facility, having limited assembly activities, is less affected by such occurrences than is Plant 2.

Part. No. 59 Manager - Industrial Engineering

This manager differed extensively from the group as was noted from the correlation analysis. He is one of the few to give high valuation to the need for long range planning and the only one to give similarly high evaluation to establishing an OR-System Analysis function. The latter need was rated in the bottom ten by the group as a whole. This particular evaluation might have been predicted because this manager is its main proponent and has been actively working toward having such an activity within Industrial Engineering. This might also explain the low composite evaluator of this need.

Several of the items he gave low evaluation to are unique and are of special interest because they were mentioned several times as being in the top ten by other individuals.

Part. No. 60 Director of Purchases

This individual had the smallest correlation coefficient of any of the individuals when his IOV were correlated with the composite OV.

His high evaluations match his specific responsibilities quite closely; he gave high evaluation to part control, make or buy analysis technique, receiving mechanization, inventory control analysis, etc. All of these can be seen to have relation to his responsibilities of purchasing and inventory control. The items that he evaluated at the low end of the scale were recruitment problems, performance measurement, as well as expansion of the organizations management design activity. This last item is in direct opposition to the group as a whole and only in agreement with Part. No. 61. This evaluation might be attributed to the size of the purchasing organization, the nature of the work, and management techniques used within that organization.

Part. No. 61 Manager - Equipment and Tooling

This manager's set of IOV was also not as highly correlated with the composite as other individuals'. He agreed with Part. No. 60 in evaluating management design in the bottom ten needs but in turn gave high evaluation to needs covering individual objectives and performance measurement using these objectives, which is somewhat inconsistent. His high evaluation of the need for project cost analysis techniques is related to his responsibility for tooling and equipment and would be of direct benefit to him. Of particular interest in his low evaluation of manufacturing research. This is a function that he might have been expected to favor because of its association with his responsibilities, but it came out in his bottom ten. His low evaluation of lateral transfer possibilities would also be expected from the nature of the people in his area. They are all experts in a particular phase of the operation and could not easily be replaced for training or other purposes.

The general conclusion to be reached from this analysis is that the evaluation process did a reasonable job of presenting a composite picture of how the individuals evaluated the needs as opportunities. It had been expected that the individual evaluation results would be more representative of the individual that made them and could be matched with his interest and responsibilities. This was not the case except for a few rather weak examples and only one that could be termed a strong example (Part. No. 59's evaluation of Operations Research). From the viewpoint that the team was supposedly evaluating the needs on the basis of the Manufacturing Division as a whole and not on the basis of their own responsibility, the analysis shows that they apparently did just that. The differences would appear to reflect differences in the individual and his method of viewing the organization situation rather than his striving to improve the activities strictly under his responsibility.

CHAPTER X

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to provide specific insight into the process of management of improvement. The particular environment studied was that of an industrial organization and the individuals carrying out the process were managers and professionals in the organization. A corollary purpose was to explore the ramifications of a specific technique for giving preliminary evaluation to the identified improvement needs.

Related to this purpose, which is general in nature, were a set of specific objectives which were used as a guide in the design of the study and the analysis of its results. They were:

1. Development and implementation of a methodology for studying and evaluating the process in a specific organization.
2. Evaluation of the process in terms of the characteristics of the individual participating in the study.
3. Evaluation of the process in terms of formal and informal structures of the organization.
4. Evaluation of the preliminary feasibility evaluation technique in terms of the individuals carrying out the evaluation.
5. Identification of characteristics of the process that have general application outside of the particular industrial environment studied.

The format of this chapter will be to present the conclusions relative to those specific objectives first, then general conclusions and observations. In each case the objective will be discussed in terms of the conclusion reached, recommendations for application of this conclusion, and recommendations for further research.

Specific Conclusions

Objective 1. Development and Implementation of a Methodology for Studying and Evaluating the Process in a Specific Organization.

This report describes the design and implementation of a methodology for studying the need identification process. This is covered in Chapters II, III and IV. In Chapters V through IX, the results of an actual application of this methodology are analyzed and evaluated. Therefore it is concluded that this first objective has been satisfied.

Application of this methodology to other organizations and other environments is recommended. Broader application would serve to verify the usefulness and value of this approach to managers concerned with improvement activities in any type of organization.

Recommendations for further research would be in regard to broader applications of this methodology in an effort to substantiate these findings and establish new relationships. The obvious necessity is that this approach should be studied in a wide range of organizational environments. By expanding the scope of the investigation, the general significance of results could be established. A specific requirement in performing a study of increased magnitude encompassing many organizations would be the development of a general classification scheme that could be applied to the identified improvement needs. This would make it possible to compare perceptive performance among organizations and to negate the effects peculiar to specific organizations. The use of psychologists and social scientists in designing the data gathering mechanism is also recommended.

Specific research activity to study the effects of the classification technique upon identification of clusters of individuals within the organization would be beneficial, as would investigation of the factors controlling or affecting the perceptive-cognitive abilities of individuals in an organizational environment. And as it is not possible to observe perception itself but only its results, techniques for verbalizing and gathering improvement need perceptions made by organization members is opportune and appropriate.

Objective 2. Evaluation of the Process in Terms of the Characteristics of the Individual Participating in the Study.

The evaluation performed in respect to this objective was carried out in two parts. The first compared individual characteristics with an index of perceptions by the participant and was described in Chapter V. Ths second comparison studied the relationship between individual characteristics and the content of an individual perceptions as determined by the classification scheme and was described in Chapter VI.

The conclusion, for the first analysis, is that the best perceivers in terms of quantity or count of perceptions are either those individual having reached the top levels in the organization or those progressing rapidly up the ranks of the organization. This conclusion was intuitively obvious during the conduct of the study and was supported by limited statistical evidence indicating that age, managerial level, and achievement index were related to perception results.

The conclusion, for the second analysis, is that the content of an individual's improvement need perceptions are dependent upon both the type and extent of an individual's memberships and the amount and type of training activity and conference attendance he has participated in. Other relationships identified in Chapter VI will be discussed under Objective 3 as they relate primarily to the structure of the organization.

The recommendation for application of these conclusions are for their use in selecting individuals to participate in improvement need identifying activities. The Objective 3 discussion will expand the set of possible selection criteria in a structural context.

Additional research is needed in defining the relationship between improvement need perception and the characteristics of the individual perceivers. The characteristic set used here was very basic and limited to easily measured attributes for both measurement of the individual and measurement of his interface with the organization. Identification of a broader set of characteristics would make it possible to evaluate a corresponding broader set of the individual attributes in regard to perceptive performance. The other approach indicated in this research is the study of those individuals whose scores for perception of improvement needs are high in an effort to identify underlying reasons for this performance level.

<u>Objective 3. Evaluation of the Process in Terms of Formal and Informal Structures of the Organization</u>.

The study concluded that there are very definite associations between what improvement needs are identified by an individual and his location in the formal structure of the organization. The strongest link is with his functional area of responsibility and its associated needs. A considerably less well defined link is the vertical location of the individual.

Conversely, the informal structure was able to demonstrate little influence upon need perception and it must be concluded that the facets of informal structure examined have limited relevance to the need identification process as investigated in this study.

Recommendations for application parallel those given for Objective 2, and are that selection of individuals to perform an improvement need identification activity should be done with adequate representation from all horizontal and vertical segments of the organization.

Additional research effort is desirable in further evaluation of the relationship between what an individual identifies as improvement needs in an organization and his interfaces in the various aspects of the informal structure of that organization. Identification and evaluation of different facets of the informal structure, as well as improved evaluation of those identified in this study, would be paramount to successful study of this relationship.

<u>Objective 4. Evaluation of the Preliminary Feasibility Evaluation Technique of the Individuals Carrying out the Evaluation</u>.

It can be concluded from the evidence shown, that the evaluation technique provides an effective means of developing a composite evaluation by a group of individuals. It was also demonstrated that the composite does not appear to be unduly influenced by preestablished relationships among these individuals.

It can also be concluded that individual heterogeneity will result in differences in the needs emphasized in an application of individual evaluations by this technique. This occurs regardless of high overall agreement among the individual evaluations. In the situation studied, the relationships among the individual evaluations were not matched by relationships established by improvement need perception nor by evaluation criteria (factor) ranking. However, differences in individual emphasis of certain needs could, in some instances, be seen to coincide with past assignments, functions, and the viewpoints expressed by the individual.

A recommendation for application of this evaluation model would be that the composite, while valid as a concensus, not be used as the sole means of selecting improvement projects. Instead, selection of those needs warranting further study should be made from an expanded set including high ranking needs from individual evaluations as well as the high ranking needs from the composite.

Further research in this area of evaluation should take the following directions. First, as meaningful evaluation is critical to later activities, application of other evaluation techniques, such as described by Baker (30) in connection R and D project selection, should be investigated in this situation. Second, the connection between the results of this early evaluation process and action taken by the organization should be studied. This study would necessitate a long-term relationship being established between the company and the research team. It would entail periodic identification and evaluation of improvement needs and a continuous record of improvement activities actually undertaken. A third avenue of research would be in the determination of the composition of the evaluation team to assure effective performance of the evaluation technique in terms of criteria appropriate to the particular organization.

Objective 5. Identification of Characteristics of the Process that Have General Application Outside of the Particular Industrial Environment Studied.

The approach to the improvement need identification process that was used in this study is not related to the particular company nor the general industrial environment, so it would appear to have application in any company or in any form of organization that seeks identification of improvement needs.

If applications of a different and undefined nature are considered, then the techniques for measuring the relationship among individuals in an organization would be of specific interest. These include the Reachability, Ranking Analysis, and Cluster Analysis models used in this study and described in the Appendices.

Of specific research interest is investigation into the applicability of factor analysis as a means of identifying clusters of entities in problems of different types and magnitudes.

General Conclusions

This study by nature, as well as stated intent, sought insight into the process of improvement need identification. Some of the insights gained can be stated as follows:

1. The members of an organization are capable, through systematic utilization of their perceptive-cognitive abilities, of identifying a set of improvement needs that are both meaningful to the organization and opportune to its situation.
2. The set of the needs so identified are of varying usefulness to the organization.
3. The response of the individual in terms of how many perceptions he has concerning organizational needs is highly variable from individual to individual.
4. The response of the individual in terms of the content of his perceptions is generally broad and goes beyond what might have been hypothesized prior to this study.
5. A preliminary feasibility evaluation technique is an appropriate adjunct to the process studied in that it provides a means for giving an initial scaling to the relative importance of the improvement needs identified.

The basic hypothesis has been that the overall approach utilized is an effective one in aiding an organization in identifying improvement needs. This hypothesis is accepted. In the analysis of this approach a set of specific objectives were developed and conclusions were reached in regard to each of them. The specific conclusions reached are not shocking. They could be called in many cases, intuitively obvious. They are, however, a beginning in the study of a process that is vital to organizations seeking improvement. They are of somewhat limited significance due to the narrowness of the research environment. They are, however, an indication of opportunities for meaningful action on the part of these organizations and meaningful action on the part of interested researchers.

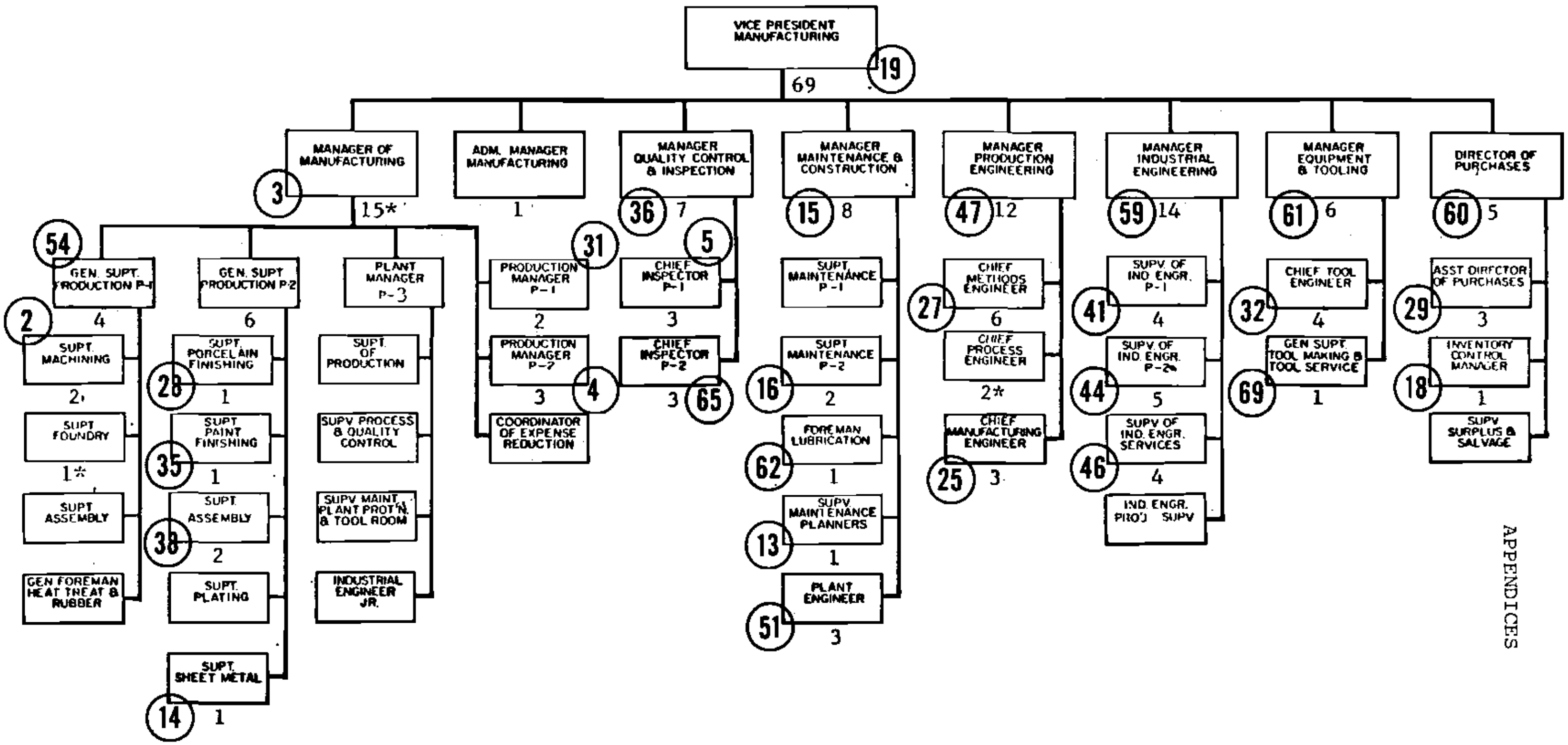
The recommendations given in this section and the previous section were directed toward the particular phase of the improvement process studied, the need identification phase. However, there are a number of recommendations for additional research that go beyond this phase. Most obvious is the examination of the process of managing the improvement function; investigation of how the organization makes use of the set of identified improvement needs and develops a specific strategy for satisfaction of these needs. A related study would be the investigation of the relationship between the improvement management process and outside change agents. This would include the comparison of the effects of using organization members for need identification, strategy development, and implementation versus the utilization of consultants in these activities.

Contribution to Field

Historically, Industrial Engineering has been concerned primarily with the analysis and synthesis of closed systems, or ones that could be reasonably assumed to be closed. These have been problems that have been highly structured and that lend themselves reasonably well to a set of techniques widely identified as those of industrial engineering - operation research - management science. However, Industrial Engineering must be concerned with problems beyond this traditional and well-defined set. In addition to the sciences, these problems of a larger scope and broader significance require the disciplines of organization theory and psychology, as well as the social and behavioral sciences. This particular investigation is an exploration into this difficult realm and provides insight into an aspect of the organization that has received limited attention. In particular the study has resulted in a quasi-analytical model of organization strategy in regard to improvement within an operating division of an industrial concern. It is an extension of industrial engineering into an expanded and less well defined problem environment but one which holds promise of providing significant inroads toward a more fundamental understanding of the underlying processes.

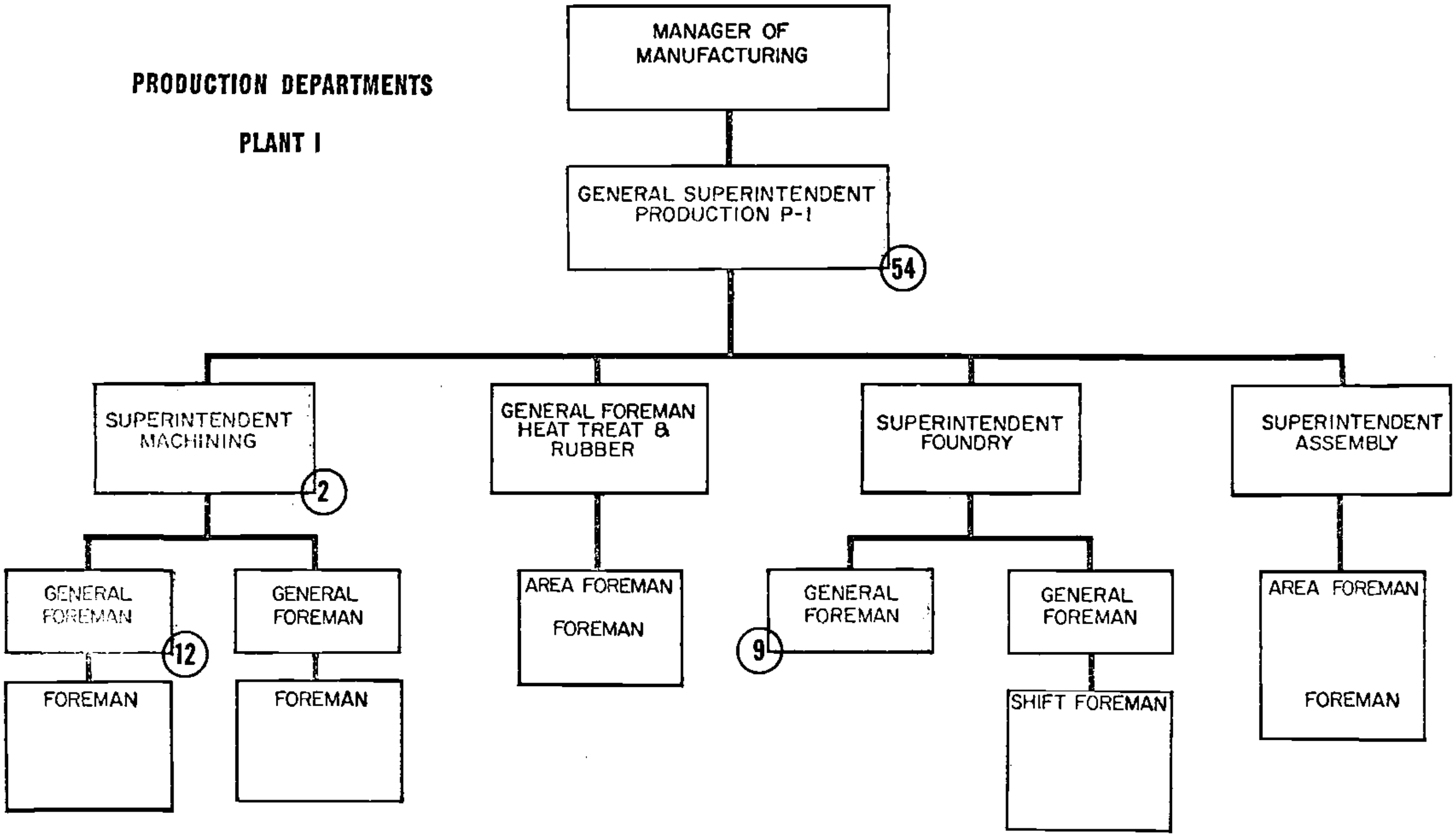
Note regarding charts in the following Appendices:

In the interest of exactness, these charts are reproduced as they were received, although the quality of reproduction varies considerably.


VICE PRESIDENT MANUFACTURING
19
69
MANAGER OF MANUFACTURING
3
15*
ADM. MANAGER MANUFACTURING
1
MANAGER QUALITY CONTROL & INSPECTION
36
7
MANAGER MAINTENANCE & CONSTRUCTION
15
8
MANAGER PRODUCTION ENGINEERING
47
12
MANAGER INDUSTRIAL ENGINEERING
59
14
MANAGER EQUIPMENT & TOOLING
61
6
DIRECTOR OF PURCHASES
60
5
GEN. SUPT. PRODUCTION P-1
54
4
SUPT. MACHINING
2
2
SUPT. FOUNDRY
1*
SUPT. ASSEMBLY
GEN FOREMAN HEAT TREAT & RUBBER
GEN. SUPT. PRODUCTION P-2
6
SUPT. PORCELAIN FINISHING
28
1
SUPT. PAINT FINISHING
35
1
SUPT. ASSEMBLY
38
2
SUPT. PLATING
SUPT. SHEET METAL
14
1
PLANT MANAGER P-3
SUPT. OF PRODUCTION
SUPV PROCESS & QUALITY CONTROL
SUPV MAINT. PLANT PROT'N. & TOOL ROOM
INDUSTRIAL ENGINEER JR.
PRODUCTION MANAGER P-1
31
2
PRODUCTION MANAGER P-2
4
3
COORDINATOR OF EXPENSE REDUCTION
CHIEF INSPECTOR P-1
5
3
CHIEF INSPECTOR P-2
3
65
SUPT. MAINTENANCE P-1
SUPT. MAINTENANCE P-2
16
2
FOREMAN LUBRICATION
62
1
SUPV MAINTENANCE PLANNERS
13
1
PLANT ENGINEER
51
3
CHIEF METHODS ENGINEER
27
6
CHIEF PROCESS ENGINEER
2*
CHIEF MANUFACTURING ENGINEER
25
3
SUPV. OF IND. ENGR. P-1
41
4
SUPV. OF IND. ENGR. P-2
44
5
SUPV. OF IND. ENGR. SERVICES
46
4
IND. ENGR. PROJ SUPV
CHIEF TOOL ENGINEER
32
4
GEN SUPT. TOOL MAKING & TOOL SERVICE
69
1
ASST DIRECTOR OF PURCHASES
29
3
INVENTORY CONTROL MANAGER
18
1
SUPV SURPLUS & SALVAGE

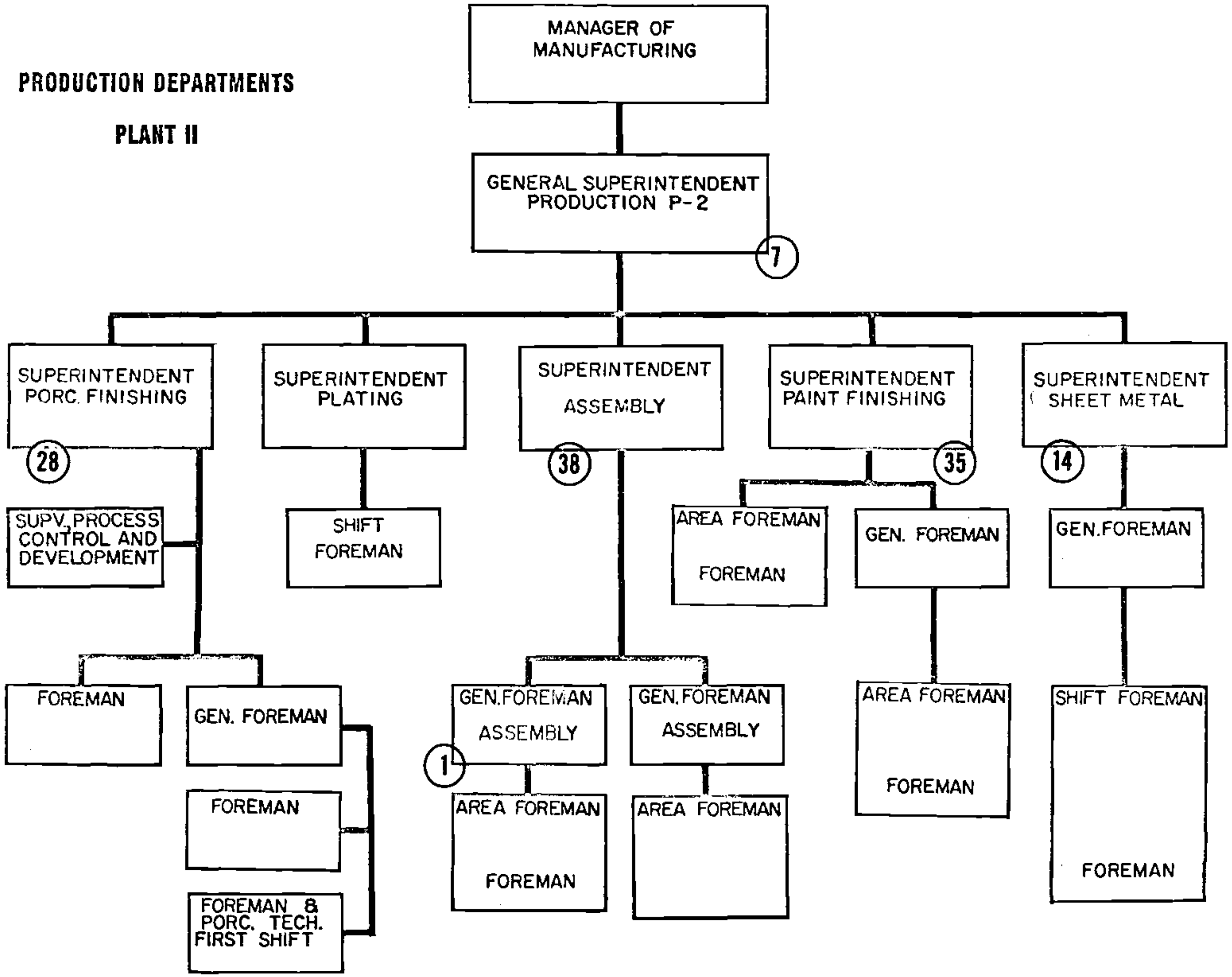
PRODUCTION DEPARTMENTS

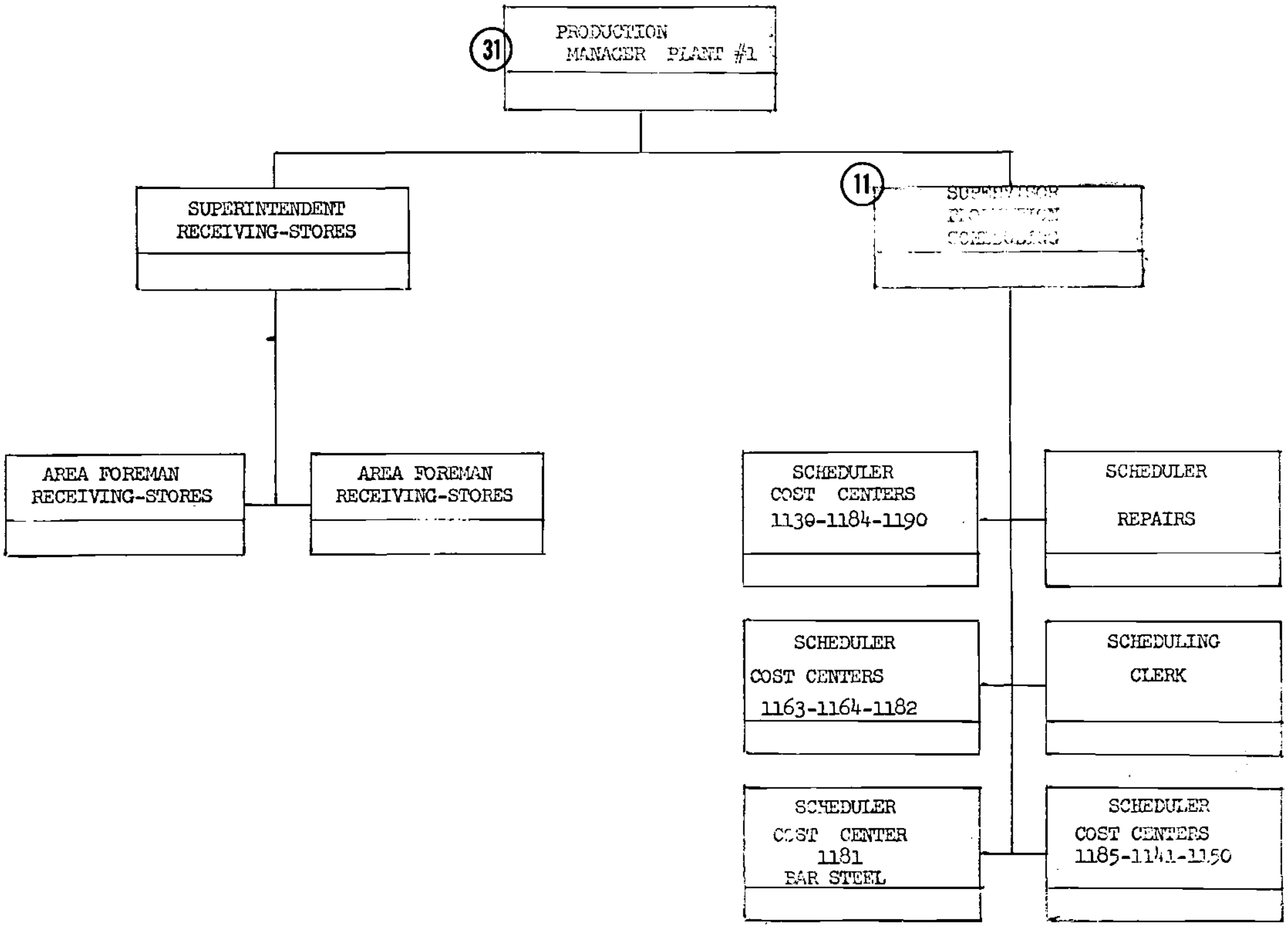
PLANT I

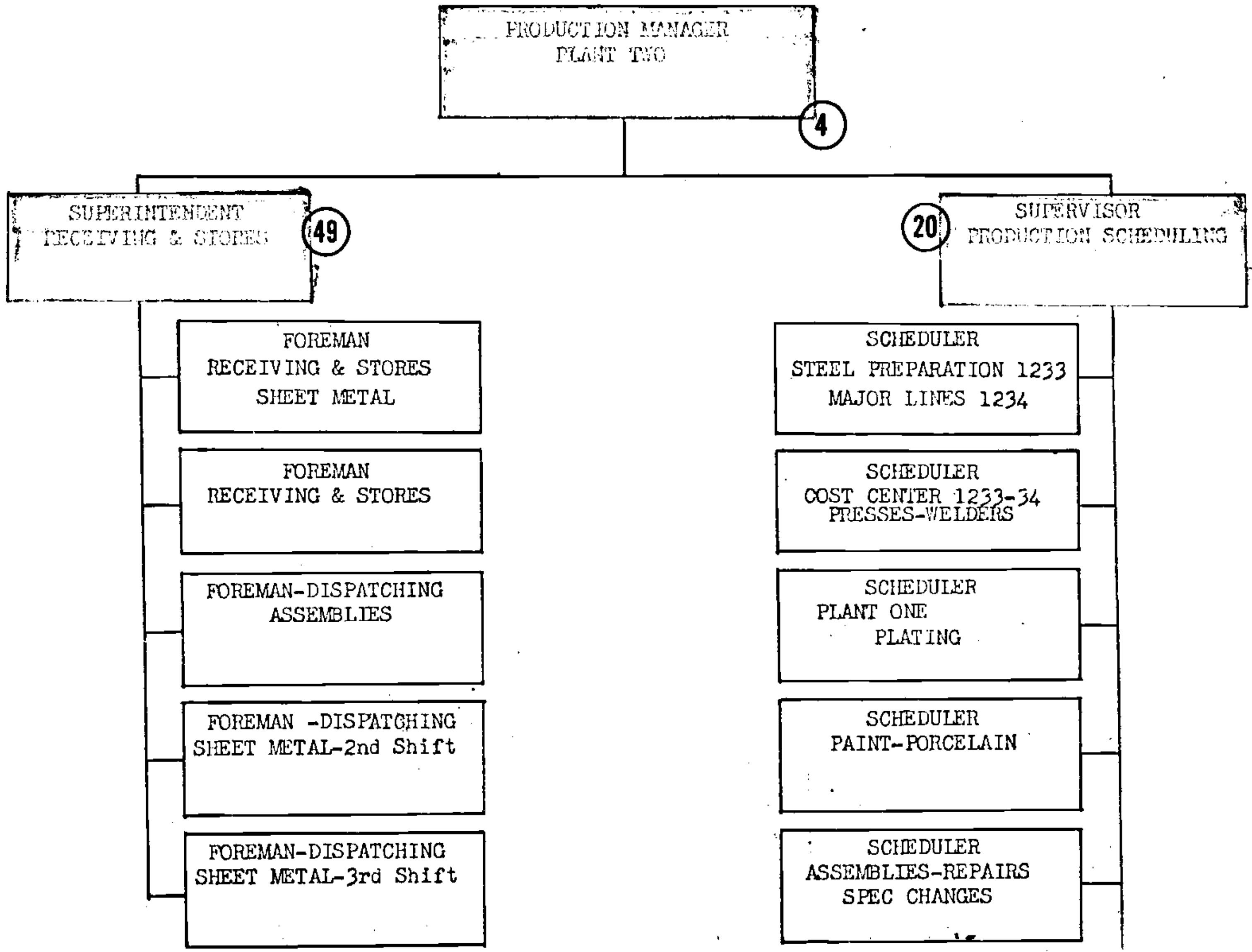


PRODUCTION DEPARTMENTS

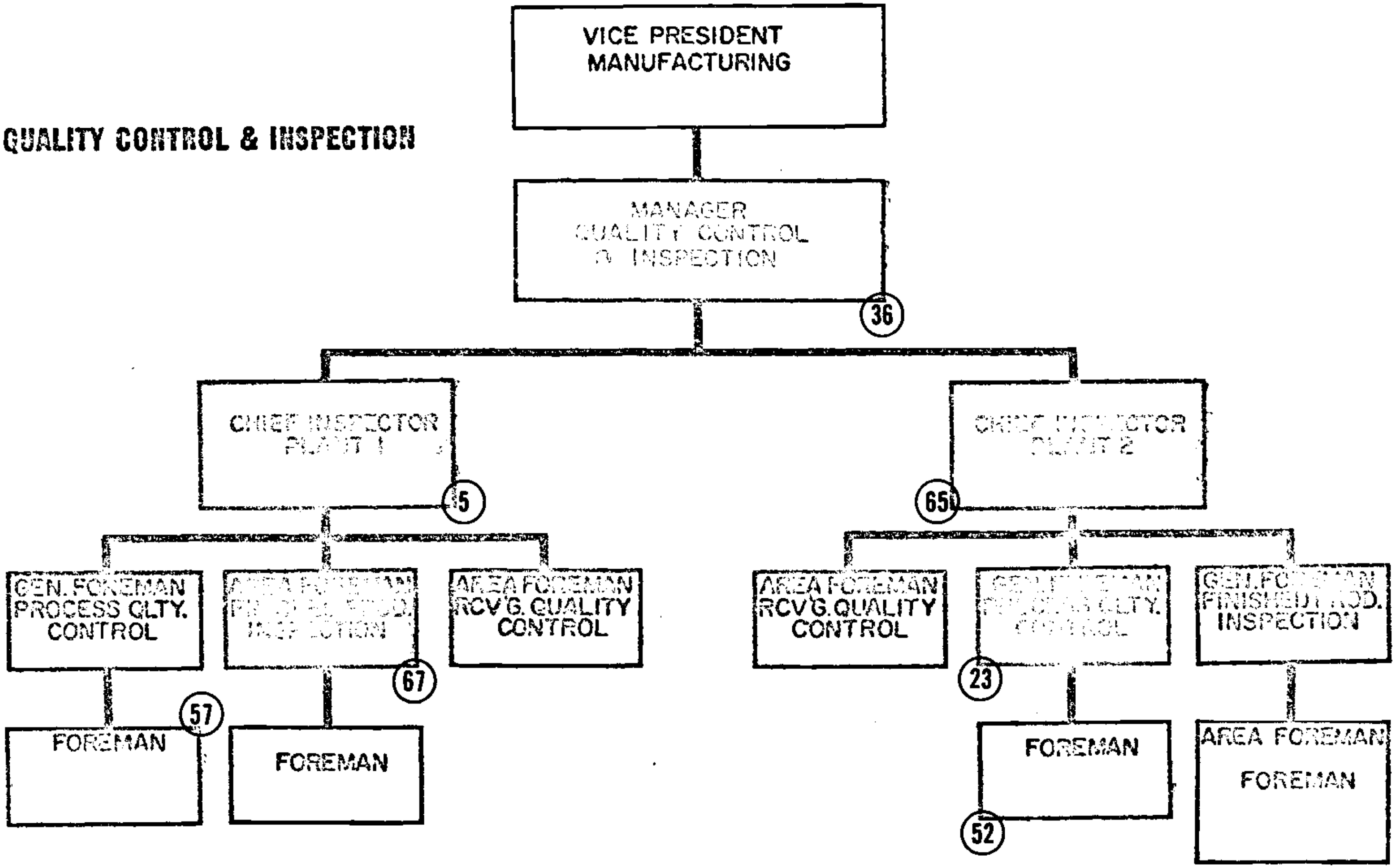
PLANT II



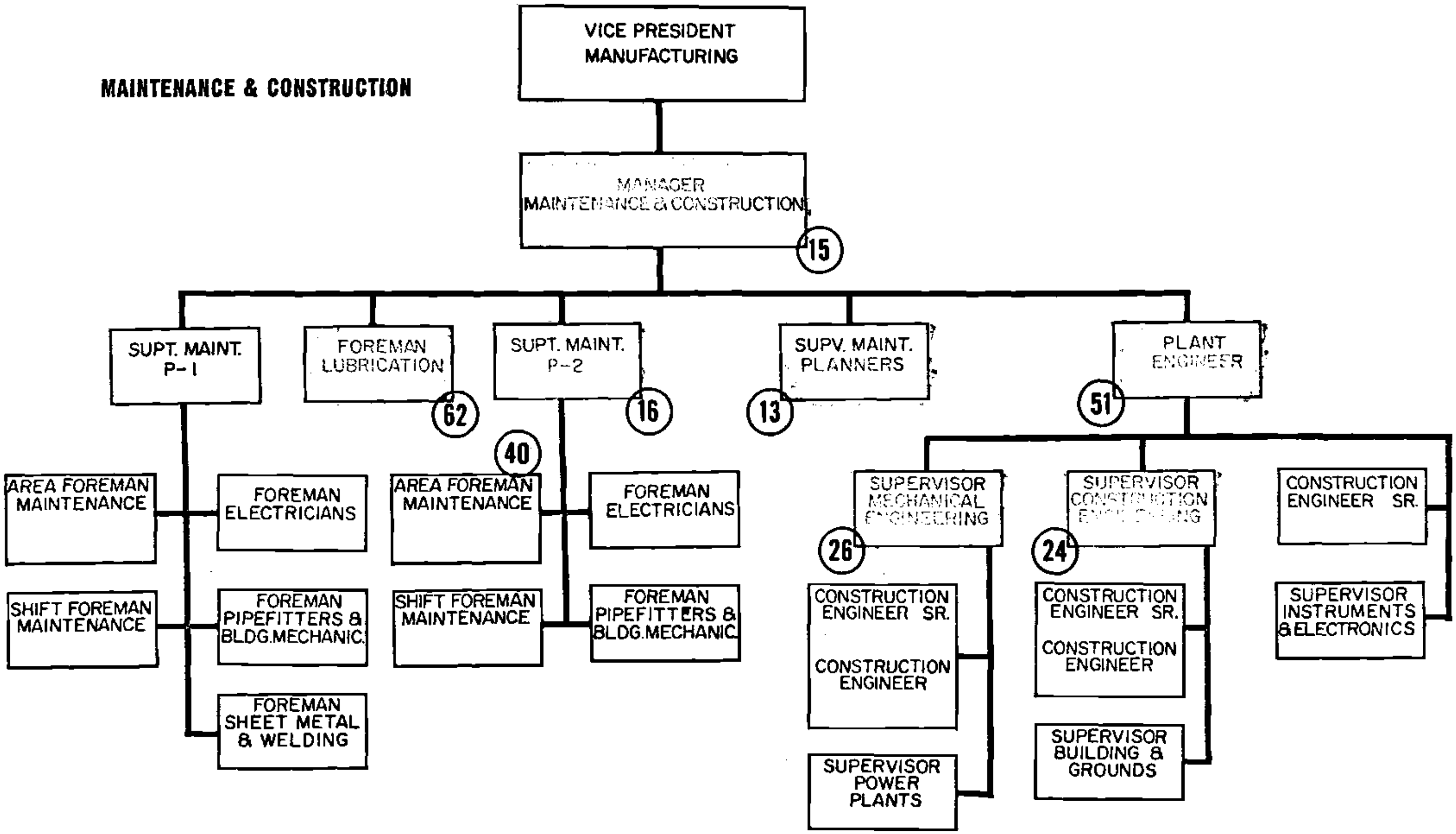

31
PRODUCTION MANAGER PLANT #1
SUPERINTENDENT RECEIVING-STORES
11
AREA FOREMAN RECEIVING-STORES
AREA FOREMAN RECEIVING-STORES
SCHEDULER COST CENTERS 1130-1184-1190
SCHEDULER REPAIRS
SCHEDULER COST CENTERS 1163-1164-1182
SCHEDULING CLERK
SCHEDULER COST CENTER 1181 BAR STEEL
SCHEDULER COST CENTERS 1185-1141-1150


PRODUCTION MANAGER
PLANT TWO
4
SUPERINTENDENT
RECEIVING & STORES
49
SUPERVISOR
PRODUCTION SCHEDULING
20
FOREMAN
RECEIVING & STORES
SHEET METAL
FOREMAN
RECEIVING & STORES
FOREMAN-DISPATCHING
ASSEMBLIES
FOREMAN -DISPATCHING
SHEET METAL-2nd Shift
FOREMAN-DISPATCHING
SHEET METAL-3rd Shift
SCHEDULER
STEEL PREPARATION 1233
MAJOR LINES 1234
SCHEDULER
COST CENTER 1233-34
PRESSES-WELDERS
SCHEDULER
PLANT ONE
PLATING
SCHEDULER
PAINT-PORCELAIN
SCHEDULER
ASSEMBLIES-REPAIRS
SPEC CHANGES

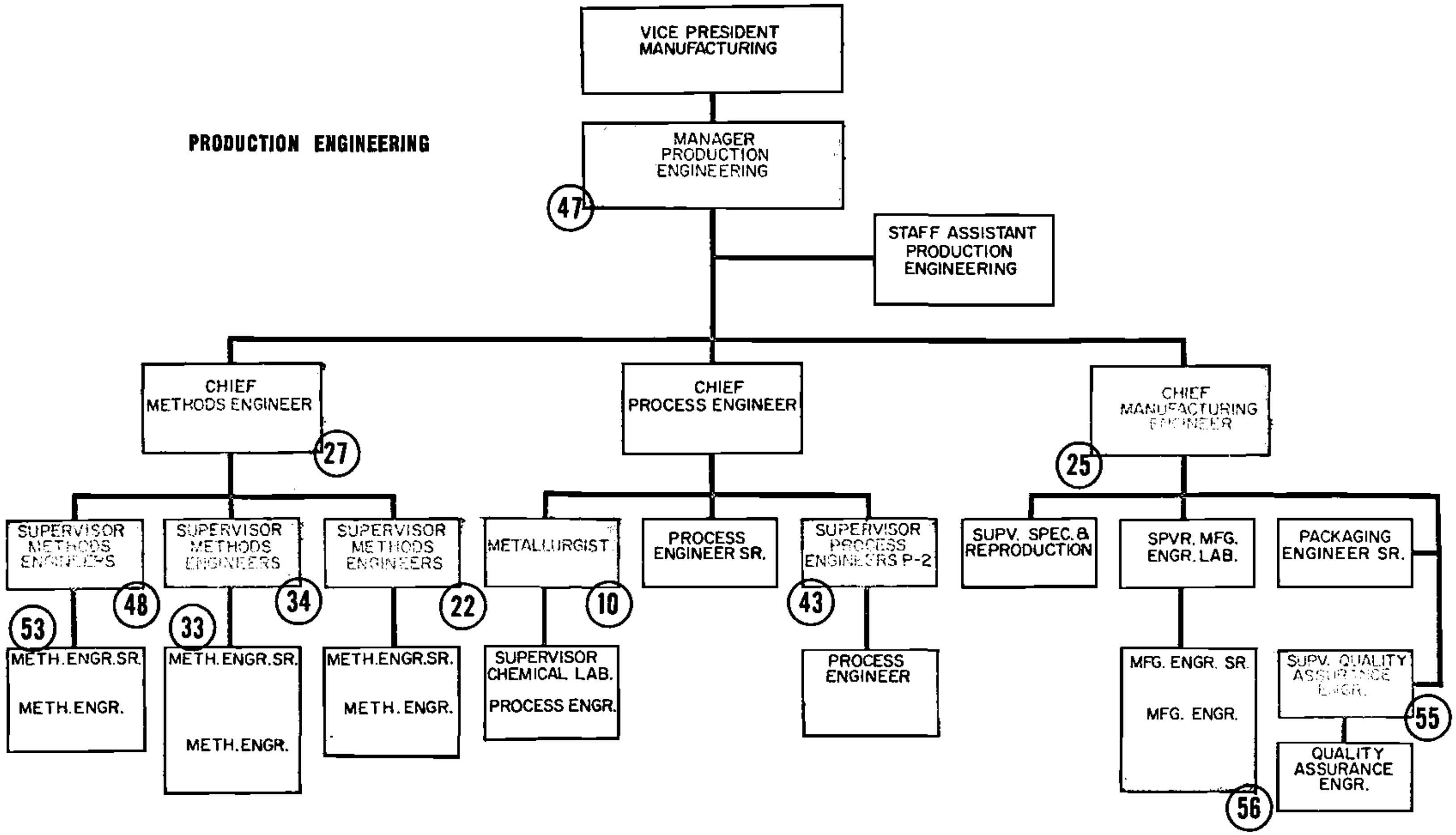
QUALITY CONTROL & INSPECTION



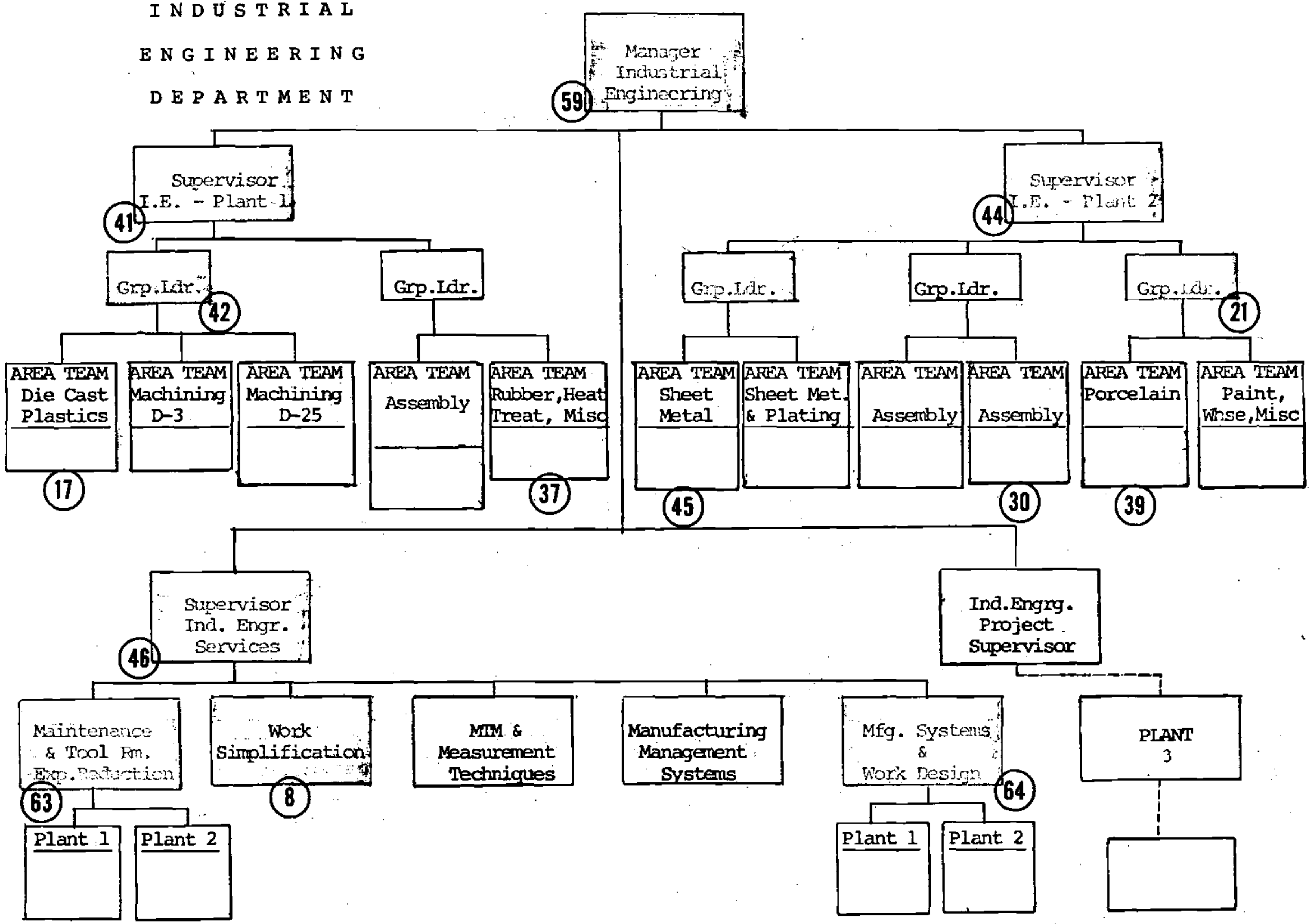
MAINTENANCE & CONSTRUCTION



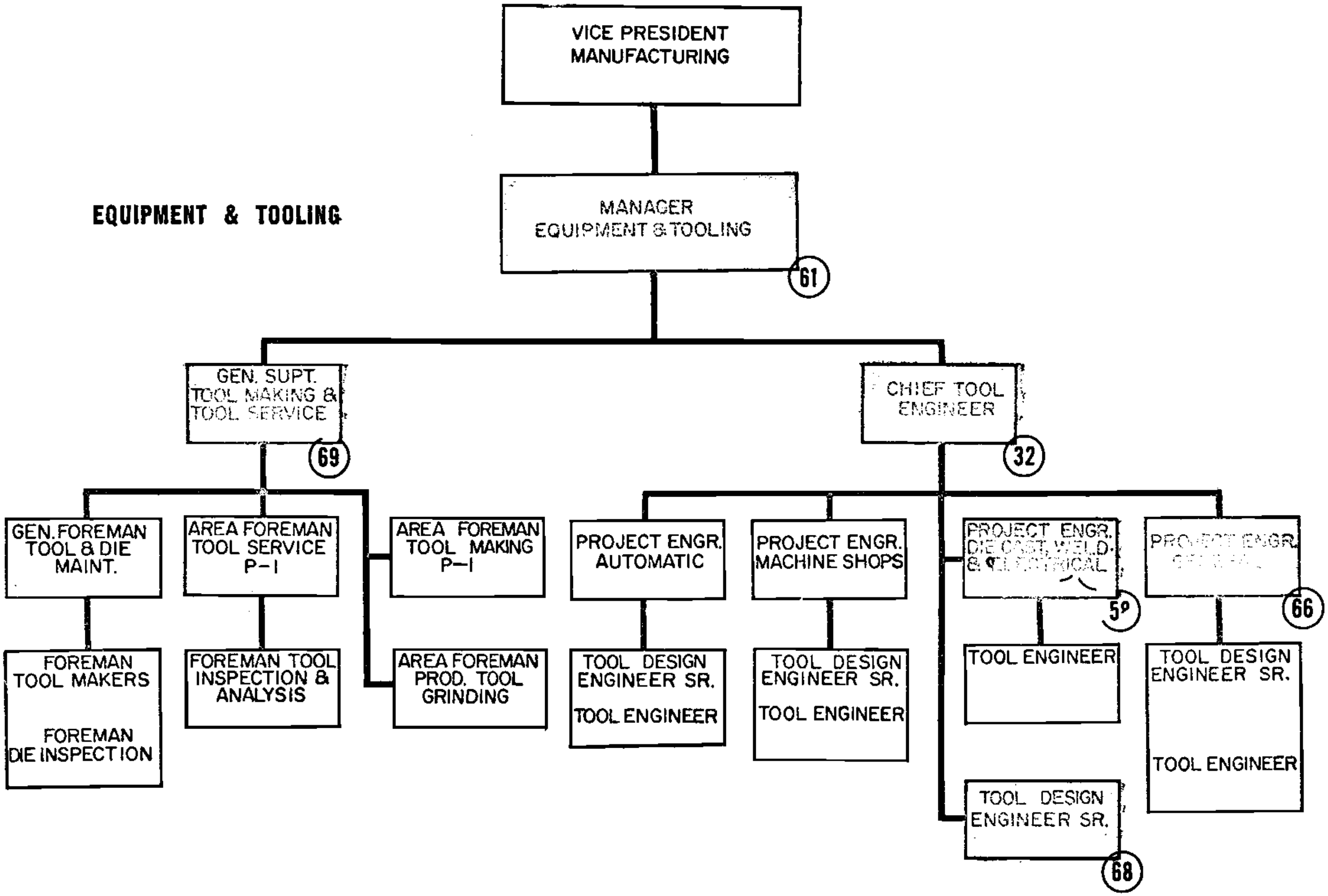
PRODUCTION ENGINEERING



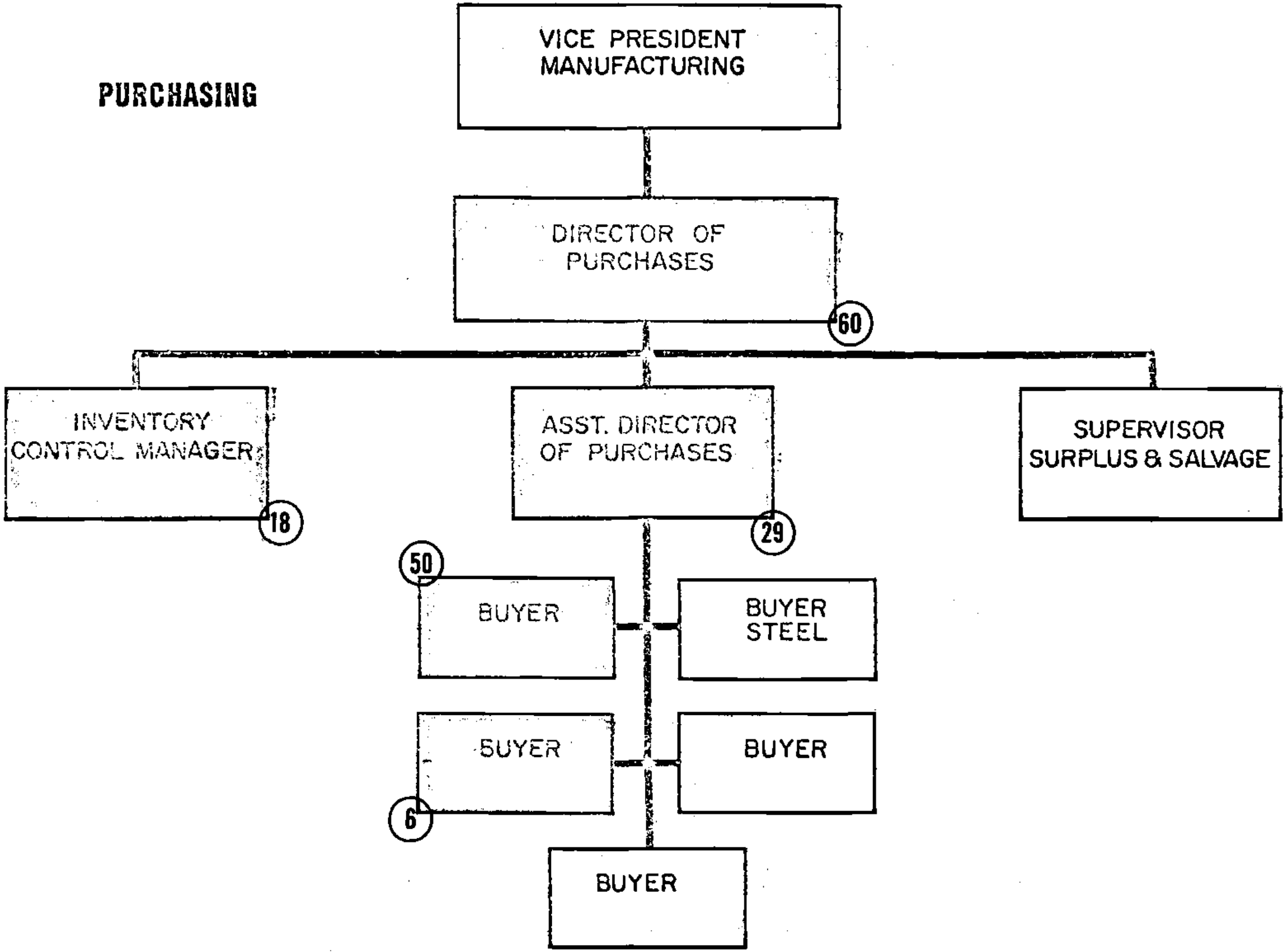
INDUSTRIAL ENGINEERING DEPARTMENT



EQUIPMENT & TOOLING



PURCHASING


VICE PRESIDENT MANUFACTURING
DIRECTOR OF PURCHASES
60
INVENTORY CONTROL MANAGER
18
ASST. DIRECTOR OF PURCHASES
29
SUPERVISOR SURPLUS & SALVAGE
50
BUYER
BUYER STEEL
BUYER
6
BUYER
BUYER

APPENDIX 2

PARTICIPANT CODING

Participant Number	Group	Title	Organization
1	D	General Foreman - Assembly	Manufacturing, P-2
2**	B	Superintendent, Machining	Manufacturing, P-1
3*	A	Acting Manager of Manufacturing	Manufacturing
4	B	Production Manager	Manufacturing, P-2
5	B	Chief Inspector	Quality Control and Inspection, P-1
6	C	Buyer	Purchasing
7*	B	General Superintendent of Production	Manufacturing, P-2
8	D	Coordinator of Work Simplification	Industrial Engineering
9	C	General Foreman	Manufacturing, P-1
10	C	Metallurgist	Production Engineering
11	C	Supervisor Production Scheduling	Manufacturing, P-1
12	D	General Foreman, Machining	Manufacturing, P-1
13	B	Supervisor of Maintenance Planners	Maintenance and Construction Eng.
14	B	Superintendent Sheet Metal	Manufacturing, P-2
15*	A	Manager - Maintenance and Construction	Maintenance and Construction Eng.
16	B	Superintendent Maintenance	Maintenance and Construction Eng., P-2

Participant Number	and Group	Title	Organization
17	D	Industrial Engineer Sr.	Industrial Engineering, P-1
18	B	Inventory Control Manager	Purchasing
19*	A	Vice President Manufacturing	Manufacturing
20	C	Supervisor Production Scheduling	Manufacturing, P-2
21	D	Industrial Engineer Group Leader	Industrial Engineering, P-2
22	C	Supervisor Methods Engineering	Production Engineering
23	C	General Foreman	Quality Control and Inspection, P-2
24	C	Supervisor Construction Engineering	Maintenance and Construction Eng.
25	B	Chief Manufacturing Engineer	Production Engineering
26	D	Supervisor Mechanical Engineering	Maintenance and Construction
27*	B	Chief Methods Engineer	Production Engineering
28	D	Supervisor Porcelain Finishing	Manufacturing, P-2
29	B	Assistant Director of Purchases	Purchasing
30	C	Industrial Engineer	Industrial Engineering, P-2
31	B	Production Manager	Manufacturing, P-1
32	B	Chief Tool Engineer	Equipment and Tooling
33	C	Methods Engineer Sr.	Production Engineering
34	D	Supervisor Methods Engineering	Production Engineering
35	D	Superintendent Paint Finishing	Manufacturing, P-2
36*	A	Manager - Quality Construction and Inspection	Quality Control and Inspection

Participant Number	and Group	Title	Organization
37	C	Industrial Engineer	Industrial Engineering, P-1
38	B	Superintendent - Assembly	Manufacturing, P-2
39	D	Industrial Engineer	Industrial Engineering, P-2
40	D	Area Foreman - Maintenance	Maintenance and Construction Eng., P-2
41	B	Supervisor of Industrial Engineering	Industrial Engineering, P-1
42	C	Industrial Engineer Group Leader	Industrial Engineering, P-1
43	C	Supervisor Process Engineer	Production Engineering, P-2
44	B	Supervisor of Industrial Engineering	Industrial Engineering, P-2
45	C	Industrial Engineer Senior	Industrial Engineering, P-2
46	B	Supervisor Industrial Eng. Services	Industrial Engineering
47*,**	A	Manager - Production Engineering	Production Engineering
48	D	Supervisor of Methods Engineering	Production Engineering
49**	C	Supt. Rec. Stores and Dispatch	Manufacturing, P-2
50	D	Buyer	Purchasing
51	B	Plant Engineer	Maintenance and Construction Eng.,
52	D	Foreman	Quality Control and Inspection, P-2
53	C	Methods Engineer Senior	Production Engineering
54*	B	Gen. Superintendent of Production	Manufacturing, P-1

Participant Number and Group		Title	Organization
55	D	Supv. Quality Assurance Engineering	Production Engineering
56	D	Manufacturing Engineer	Production Engineering
57	C	Foreman	Quality Control and Inspection, P-1
58	D	Project Engineer	Equipment and Tooling
59*	A	Manager - Industrial Engineering	Industrial Engineering
60*	A	Director of Purchases	Purchasing
61*	A	Manager - Equipment and Tooling	Equipment and Tooling
62	C	Foreman, Lubrication	Maintenance and Construction Eng.
63	D	Coord. Maint. and Tool Rm. Exp. Red.	Industrial Engineering
64	C	Coord. Mfg. Systems and Work Design	Industrial Engineering
65	B	Chief Inspector	Quality Control and Inspection, P-2
66	C	Project Engineer, Gen.	Equipment and Tooling
67	D	Area Foreman	Quality Control and Inspection, P-1
68	D	Tool Design Engineer Sr.	Equipment and Tooling
69**	B	Gen. Supt. Tool Mfg. and Tool Service	Equipment and Tooling

* Evaluation Team Member

** Questionnaire Not Returned

APPENDIX 3

QUESTIONNAIRE

MANAGEMENT OF IMPROVEMENT

NAME____________________

DATE____________________

Education and Training

Type	Years	Program Type (check)			Comments
		General	Technical-Scientific	Business Oriented	
Grade School					
High School					
College					
College					
Apprentice Training					
Other					

Experience and Background

Years at Company__________ Age__________

Company Experience (in years)

Function	Responsibility			Comments
	Operational	Managerial		
		First Level	Higher Level	
?roduction				
;taff - Service (Maint., Insp., Prod. Cont.)				
:ngineering - Technical				
'ther (Acctg., Marketing Ind. Relations, etc.)				
:ultiple Responsibility eneral Mgmt., Duties				

ther Experience (in years)

roduction				
taff - Service (Maint., [nsp., Prod. Cont.)				
ıgineering - Technical				
:her (Acctg. Marketing :nd. Relations, etc.				
ıltiple Responsibility eneral Mgmt. Duties				

1. Do you have contact with individuals in other companies doing work or having responsibilities similar to yours? How were these contacts made and what is the basis for their continuation?

____

2. In what trade, business, or professional organizations do you hold memberships?

____

3. What trade, business, or professional journals do you read? What percentage of the material in these publications do you find applicable to your work? What percentage of this applicable material do you have an opportunity to read? What prevents you from reading more of it, if you are unable to read all of it?

Journal	Applicable Material	Material Read

Reading Restrictions or Limitations:___________________________

____

4. Who are the three or four members of this organization, meaning the entire company, that you meet most frequently on social occasions?

Name	Organization or Title

5. Who are the three or four members of the company in your conversations with whom the subject of your work and your problems most often comes up?

____

6. When you need added information or advice on questions concerning your work and area of responsibility, who are the three or four members of the company you are most likely to contact? What other sources are you likely to use?

____

Other Sources:____

7. Who are the members of the company that you most often work with on joint projects and assignments?

____

8. How would you rank the importance of the following characteristics in recognizing a good manager in a company and community such as this one?

____ a. His general standing in the community.

____ b. The respect in which he is held by his subordinates.

____ c. The respect and recognition given him by his fellow managers.

____ d. The recognition given him throughout industry, possibly due to research, publications, or participation in professional activities.

____ e. The recognition given him by his superiors.

9. How would you rank the following 'philosophies of management' in terms of the type likely to be used by good managers in companies and communities such as this one?

____ a. Adequate organization performance is possible through balancing the necessity to get out work with maintaining morale of people at a satisfactory level.

____ b. Thoughtful attention to needs of people for satisfying relationships leads to a comfortable friendly organization atmosphere and work tempo.

____ c. Efficiency in operations results from arranging conditions of work in such a way that human elements interfere to a minimum degree.

____ d. Work accomplishment is from committed people; interdependence through a 'common stake' in organization purpose leads to relationships of trust and respect.

____ e. Exertion of minimum effort to get required work done is appropriate to sustain organization membership.

10. How would you rate your influence on the decision making by individuals in the Manufacturing Division and your Department? (Consider your immediate superior, all immediate subordinates, and any others in the organization whom you influence.) Check term

that best describes your influence in relation to individual named.

	Name	None	Limited	Moderate	Considerable	Extreme	Complete
Superior:							
Subordinates:							
Others:							

11. How would you rate your superiors' influence on your decision making:

Superior:							
Others:							

12. How would you rank the following personal attitudes in relationship to those likely to be held by successful managers and professionals in situations similar to your own?

____ a. Quality of work is of prime importance. Change is not a desireable thing when the system is operating smoothly. Knowing the job and performing satisfactorily are important goals to be achieved and maintained. Specific direction should he provided by higher levels in the organization.

____ b. Lack of fears of survival, of the boss, or social disapproval. Confident of his ability to survive. Sees his task as getting the job done, not getting it done in a certain way. Places emphasis on his own self-esteem. Resists standard procedures and desires work independence. Lacks any strong group loyalty.

____ c. Strong desire for fairness. Desire for conformity and stability. Favors a team approach to problem solving. Recognition within the group considered very important. A congenial work atmosphere and comfortable work pace are very important.

____ d. High energy level. Security is achieved through hard work. Ends justify means, risk is inherent in good performance. Believes in the power of self. It is the right of leaders to set the rules. Organizational power is an important measure of ability. Performance justifies 'beating the system' and challenging all policies and procedures.

____ e. Work is required to provide basic needs. Understanding of the work situation is not required. Performing as demanded in order to fulfill needs is the only important requirement that work makes. Complete subordination to superior power and susceptible to force.

13. How would you modify the previous ranking of personal attitudes in relationship to successful managers and professionals in employment situations immediately below your level?

____ a.

____ b.

____ c.

____ d.

____ e.

14. How would you modify the ranking of personal attitudes in relationship to those likely to be held by successful managers and professionals in employment situations immediately above your level?

____ a.

____ b.

____ c.

____ d.

____ e.

15. What conferences, meetings, training programs, seminars, etc., have you attended in recent years? What year did they take place?

Title - Subject	Year
______________________________	________

16. In your own organization within the company, who are the members that you would identify as idea people, creative people, innovators, etc.?

Name	Organization Or Title
______________________	______________________

17. Outside of your own organization, who are the members that you would identify as idea people, creative people, innovators, etc.?

____

APPENDIX 4

FUTURE PREDICTIONS

100 Results

110 General

110 (a) A continuing cost-price squeeze which probably will reduce modestly the per share earnings.

(37-Agree, 5-No Opinion, 25-Disagree, 23-Comments.)

The reason for disagreement was almost universal: the price squeeze is expected, but the organization will overcome it effect upon earnings by increased volume, improved efficiency, better management, product line expansion, etc.

110 (b) A volume possibly 20% to 30% higher than present in dollars.

(48-Agree, 8-No Opinion, 11-Disagree, 23-Comments.)

Disagreement was over the estimated, percentage these participants usually saw greater growth, from 50% to 100% in the ten year period. Those with no opinion felt they lacked the necessary marketing data to make an evaluation.

120 Specific

120 (a) Phasing out of current products.

(27-Agree, 10-No Opinion, 30-Disagree, 31-Comments.)

Agreement with this statement was generally accompanied by comments that the conventional would be gone in ten years, there would be all new models, and there would be a possibility that phasing-out could happen to all current products. Disagreement was either that it would not happen at all, including conventional, or that if it did, the phasing out would not present a difficult or important problem to the organization.

120 (b) Possible changes in consumer requirements (i.e., paper clothes, new fabrics, etc.)

(57-Agree, 3-No Opinion, 8-Disagree, 31-Comments.)

The general reaction was that this is a possibility and if it happens it could be vital to Company. Therefore it is an important consideration in Company's future. Disagreement was voiced in terms of these changes not occurring within ten years, or that if they did, the organization could handle the problem.

120 (c) Expansion of product line.

(64-Agree, 1-No Comment, 2-Disagree, 16-Comments.)

The only disagreements with this prediction were backed by comment that the company had not done this in the past and therefore it was unlikely that this would happen in the future regardless of the desirability of such action. The comments in agreement indicated the necessity of this action if Company is to continue to grow and if it is to provide opportunities for its employees. Hope and personal desires could be seen to influence this decision.

120 (d) A product line basically the same as at present with one or two closely related products.

(36-Agree, 1-No Comment, 30-Disagree, 24-Comments.)

The comments made in agreement indicate that while this may be the situation, the participant wants or hopes for greater expansion, including other product lines. The most of the disagreement comments were saying that there would be more expansion than this statement indicates. This latter comment also seemed to indicate an optimism about the future rather than a conviction.

120 (e) Expansion of overseas market.

(35-Agree, 18-No Comment, 14-Disagree, 26-Comments.)

Most of the comments indicate recognition that a market potential exists overseas but there are considerable problems to be overcome. There were also comments that indicate that while desirable, participants would not want activity in this sector of the market to dilute United States growth activities.

200 Objectives

210 Defining the existing of the Company and Division

210 (a) No manufacturing facilities at other locations.

(22-Agree, 12-No Opinion, 33-Disagree, 41-Comments.)

A general feeling of the participants seemed to be that if the company was going to expand, it could not be done in N.... because of a shortage of labor. A number of others felt this was too limiting a statement and that such a decision should be based upon the needs and economies of the situation whenever the decision had to be made. A few thought H.... should be consolidated into the N.... for economic reasons, such as costs of operating a separate facility and the costs of people traveling to and from H....

220 Defining the direction of the Company and Division

220 (a) More concern for consumer

(54-Agree, 1-No Opinion, 12-Disagree, 23-Comment.)

Most participants agreed with the need for more concern. All seemed to agree with the need for some concern, but those that disagreed with the statement commented in one of these categories: first, concern is already too high; second, concern can't be any higher; third, concern for customers is at the proper level now and should not be increased.

220 (b) A tighter company-union relationship, somewhat more restrictive to the company.

(38-Agree, 12-No Opinion, 17-Disagree, 16-Comments.)

The concensus was that Company has good relations with the union. These that disagreed seemed to do so on the idea that it wouldn't be any worse in the future.

230 Planning for the future of the Company and Division

230 (a) Increased emphasis on planning and prediction.

(65-Agree, 1-No Opinion, 1-Disagree, 8-Comments.)

Comments indicated the need for improved methods as well as emphasis. The only disagreement was voiced in terms that more planning is already being done, what is really needed is new tools and techniques of planning.

300 Structure

310 Planning and Design — General

310 (a) Current organizational performance will be a primary determinent of the future environment.

(60-Agree, 3-No Opinion, 4-Disagree, 13-Comments.)

There was general agreement, according to comment, that the organization has some control on its destiny. The Disagreement appears to indicate that there are other factors that should be considered such as the effects of the organizational environment.

310 (b) Cost prevention orientation rather than cost reduction.

(51-Agree, 2-No Opinion, 14-Disagree, 25-Comments.)

The only significant disagreement to this statement seemed to be one of emphasis. Comments indicated a feeling that regardless of this emphasis there would always be cost reduction activities.

310 (c) Change-oriented environment.

(65-Agree, 0-No Opinion, 2-Disagree, 11-Comments.)

There was disagreement voiced on two bases, that the conservative nature of the company will prevent this and that quality considerations will also prevent a change-oriented environment.

320 Planning and Design — Specific

320 (a) Decentralized expansion — because of labor requirements.

(31-Agree, 9-No Opinion, 27-Disagree, 14-Comments.)

As might be expected, the point of voiced disagreement seemed to be whether or not labor would be the factor that forced decentralization.

330 Interaction

330 (a) Change environment will impose an increased load on the line, with the staff doing more long range planning and increasing its participation in decision making.

(57-Agree, 3-No Opinion, 7-Disagree, 27-Comments.)

Disagreement centered around the idea that the staff should not participate more in decision making, if line decisions are the ones being made.

330 (b) Greater differentation between line and staff work with increased dependence of the line on the staff organization.

(26-Agree, 5-No Opinion, 36-Disagree, 31-Comments.)

The disagreement seemed to rally around the idea that the line should not be more distinctly separated from the staff but that the two should work more closely together, but without increased dependence. The line should be developed so that it is not too dependent upon the staff.

400 Members

410 Planning

410 (a) A need for more staff and fewer direct personnel per unit of production.

(48-Agree, 6-No Comment, 13-Disagree, 31-Comments.)

This statement was generally recognized as the trend with no arguments given with the idea of a decrease in direct personnel. Most disagreement came in the implied growth of staff. Some participants thought staff size should also go down with increased use of new technology such as computers and operations research.

410 (b) A rapidly changing make-up of key personnel because of retirements resulting, largely, in chain reaction promotions from within. 1972 will be mid-point in the cycle running from 1970 to 1975.

(59-Agree, 4-No Opinion, 4-Disagree, 19-Comments.)

The limited disagreement is centered around the fact that in the past the company has relied upon the outside for a significant portion of its promotions. With lack of formal management development and therefore apparent lack of preparation, some participants felt that this will happen again.

420 Selection and Development

420 (a) Increasing need for excellence in Management.

(67-Agree, 0-No Opinion, 0-Disagree, 9-Comments.)

There was complete agreement with this statement. Comments were aimed at the need for management development.

430 Training

430 (a) New Technology

(67-Agree, 0-No Opinion, 0-Disagree, 4-Comments.)

Universal agreement was expressed that this is an important characteristic of **Company**'s future.

430 (b) Meaningful and extensive developments in the future in terms of manufacturing technology.

(66-Agree, 1-No Opinion, 0-Disagree, 8-Comments)

There was general agreement that development of manufacturing technology will be important to the company.

430 (c) Meaningful and extensive developments in the future in terms of the Management Sciences (E.D.P. - O.R.).

(61-Agree, 6-No Opinion, 0-Disagree, 8-Comments.)

General agreement was given with this statement, in the comments, problems exist in training people for this technology or in acquiring people with this technology.

430 (d) Meaningful and extensive developments in the future in terms of behavioral science.

(59-Agree, 6-No Opinion, 9-Disagree, 22-Comments.)

There was general agreement as to developments being made in this field, but doubt as to how much the organization might be able to actually make practical application of.

430 (e) Meaningful and extensive developments in the future in terms of Unionization.

(42-Agree, 16-No Opinion, 9-Disagree, 22-Comments.)

Disagreement centered around the feeling that unions had developed as much as was possible and that there would be a leveling off in the next ten years. Half the comments mentioned the idea of a "white-collar" union, but most seemed to feel that there was no immediate likelihood that such a union could get started at Company. However, there were instances cited where decisions made by management would tend to encourage the formation of such a group.

430 (f) Utilization of the systems approach.

(63-Agree, 4-No Opinion, 0-Disagree, 8-Comments.)

There was general acceptance of this statement as being an importance characteristic of the future.

430 (g) Increased Utilization of Data Processing.

(65-Agree, 2-No Opinion, 0-Disagree, 11-Comments.)

Again there was general agreement on this statement. Comments indicated possible applications and emphasized the need for training in this area of expanding technology.

430 (h) Increased complexity of products and technology.

(64-Agree, 1-No Opinion, 2-Disagree, 13-Comments.)

General agreement with this statement along with comments identifying that Company must recognize what this increased complexity means in terms of the organization.

440 Membership Programs

440 (a) Continued problems in retaining good employees.

(63-Agree, 0-No Opinion, 4-Disagree, 16-Comments.)

The comments indicate a feeling that management at all levels has a responsibility to keep the work interesting and challenging. Many of the participants felt this was not being done in any explicit manner. Lack of growth and its affect upon opportunities was also cited.

440 (b) Continued problems in acquiring manpower.

(59-Agree, 4-No Opinion, 4-Disagree, 26-Comments.)

There was general agreement with this statement as being the result of a larger problem of manpower shortages, especially highly skilled manpower and professionals.

Most felt that specific action by Company could ease some of the effects being felt or that are expected to be felt in the future.

440 (c) Increased reliance on technicians.

(62-Agree, 3-No Opinion, 2-Disagree, 19-Comments.)

Comments indicated a general recognition that the shortage of technical people requires that the few available must have technical assistants. Also, that the increasing complexity of production equipment means that highly technicians will be in charge of these types of operations rather than a lower skilled.

450 Effectiveness

450 (a) Increased importance of Behavioral Science Techniques.

(65-Agree, 2-No Opinion, 0-Disagree, 15-Comments.)

The only question or doubt raised was to what extent can behavioral techniques be applied and still not disrupt the function- of the organization. Problems of practicality of this approach and possibility of carrying it too far, were also commented upon.

500 Operational System

510 Planning and Control

510 (a) Increased decision making based upon cost effectiveness.

(50-Agree, 2-No Opinion, 15-Disagree, 23-Comments.)

There was not much disagreement with the basic idea of decision making on a cost-effectiveness basis, but there were significant comments on the requirement to consider non-cost factors, quality usually, in any decision making process.

510 (b) Somewhat more formalized reporting and communicating devices-a need for more automatic tools for control by importance and exception.

(64-Agree, 1-No Opinion, 2-Disagree, 14-Comments.)

Again general agreement upon the importance of this statement as a future characteristic. Comments indicate a concern for too formal technique that might destroy some of benefits of a more informal system with its personal interplay.

520 Motivation

520 (a) Decreased importance of monetary incentives.

(25-Agree, 6-No Opinion, 36-Disagree, 33-Comments.)

The participants indicated a general feeling that money would continue to be the basic motivating factor over the next ten years, but that there will be developments to bring other factors into consideration at the same time.

520 (b) An incentive application more sophisticated, more broad, and perhaps quite different from that we know at present.

(47-Agree, 13-No Opinion, 7-Disagree, 20-Comments.)

There was general agreement as to the general direction in the area of incentives, but comments indicated skepticism regarding the ability of the company to make meaningful progress in terms of the true effectiveness of these possible new incentive systems.

530 Project Management

530 (a) Shorter development-to-market span (new Products and new models).

(51-Agree, 5-No Opinion, 11-Disagree, 25-Comments.)

The comments indicate that the marketing oriented need of quick response was generally believed to be part of the future characteristics. The critical demands that this will place on the organization, especially both Manufacturing and Research and Development, is also foreseen and is the main point in disagreement.

540 Quality Management

540 (a) A quality image equal to or better than that of 1967.

(67-Agree, 0-No Opinion, 0-Disagree, 13-Comments.)

All participants agreed that the quality image will be equal to the present but the comments indicate a questioning of the provision that quality will be better in this future ten year period. The basic question seemed to be whether or not additional investment in improving the already excellent quality image would result in a return significantly better than an equal investment in a different effort.

550 Parts Management

550 (a) Trend to make rather than buy.

(61-Agree, 2-No Opinion, 4-Disagree, 14-Comments.)

General agreement was expressed with this statement, with recognition of the effects of new products having low initial volume.

560 Operations Optimization

560 (a) Production will be controlled by a highly integrated system.

(60-Agree, 5-No Opinion, 2-Disagree, 20-Comments.)

Comment on this generally acceptable statement center on questions of benefits from such a system and the ability of the organization to design and operate a really substantial production control system.

570 Processing, Facilities, and Equipment Management.

570 (a) Processing techniques, and equipment replacement and additions largely up-to-date or ahead of the then needs.

(55-Agree, 3-No Opinion, 9-Disagree, 22-Comments.)

Again, general agreement on the desirability of being ahead of the needs, but considerable skepticism as to whether the company would actually commit itself to a program requiring investment before actual demonstrated need.

570 (b) No areas of manufacture other than those presently employed, with the possible exception of wire coating and plastic extending. No motor or control manufacture.

(10-Agree, 2-No Opinion, 55-Disagree, 32-Comments.)

Participants felt that the statement was too restrictive to be applied to defining the future. Comments indicated that they felt decisions of this nature should be made at the required time and based upon facts applicable at that time. Agreement with the statement usually included a comment about Company being a specialist and therefore shouldn't be entering new areas of manufacture.

570 (c) A physical plant in good shape and with capability for output 25% to 30% beyond that in effect in 1967.

(58-Agree, 4-No Opinion, 5-Disagree, 23-Comments.)

There was general agreement with the statement as well as broad agreement in the comments that this percentage was too low if the company was to grow significantly.

570 (d) Possibly additional finishing, assembly, and stores buildings at Plant II.

(61-Agree, 3-No Opinion, 3-Disagree, 5-Comments.)

There was general recognition of this type of expansion being a characteristic of the future; comments indicated this would be the very near future.

IMPROVEMENT NEEDS PERCEIVED

100 Results

110 General Results Orientation

111 Company Growth

The general tone of the perceptions falling this category is one of dissatisfaction with the company's growth but without specific suggestion as to how this is to be remedied. Significant comments were made concerning both items that tend to promote and hinder the growth of the entire company.

120 Specific Results Orientation

121 Company growth through investment of treasury holdings

The perceptions reflect the observation that the large holdings of liquid assets could be reinvested in company growth with greater return than they are presently earning.

122 Company growth through financing of consumer credit

The statements recorded refer to the changing pattern of consumer financing that the United States is experiencing and that this might offer an approach to increased earnings.

123 Company growth through expansion of the product line within the home appliance field

The comments supporting the idea that the need for an expanded product line seem to be justified on two bases; one, that the organization needs it to survive and grow; two, that it is needed to provide more opportunities and increased job satisfaction for the members of the organization.

124 Company growth through diversification of products into areas other than home appliances

The need for diversification was tied to the survival as well as to the growth of the company. Concern was expressed for "putting all our eggs in one basket".

200 Objectives

210 Defining the existing state of the Company and Division.

211 An organization profile - a statement of the organizational reality

The perceptions that fell into this class were those reflecting the idea that in order to make meaningful decisions about the future, it is necessary to understand the present situation of the organization. That is, what are its strong points, weak points, what is the competitive situation, etc.

220 Defining the direction of the Company and Division.

221 A specific statement of company objectives and philosophy

The participants felt that the company needed a specific set of objectives or if there already was such a set, it should be communicated to the organization. There were also numerous objectives dealing with specific topics that were suggested. Some of these covered areas of product design, labor relations, community responsibilities, layoffs due to cost reductions, etc.

222 A hierarchy of objectives, for each level and each organizational unit

The comments stress the necessity of using the objective of the company as direction for all individuals and sub-units of the organization. There were also comments concerning the need to know what other subunits are doing in order for a specific subunit to determine it's own goals.

230 Planning for the future of the Company and Division

231 A long-range plan emphasizing the time phased changes in objectives

The perceptions placed in this category reflect an apparent wide spread concern for the lack of long range plans within the company and the division. The comments also reflect a recognition of the problems associated with planning as well as some of the specific plans that individuals would like to know about. An example of the latter is the comment questioning the future of Plant 1 after phasing out of the conventional washer production.

300 Structure

310 Planning and Design - General

311 Review and revise the organization structure

The perceptions of the participants indicate a recognition of the need to plan and design the organization. They also point out that the present time may be an opportune time to change the organization because of the turnover in top management that will occur shortly. A number of guides to designing the revised organization are also given such as, taking into account the predicted future in so far as it affects the organization design, consideration for new technology, and consideration of behavioral science concepts.

312 Capability and skill survey and inventory, including quantitative analysis capability

The needs identified here reflect the requirement to analyze the present organization's capabilities as part of the planning and design activity.

313 Develop specific responsibility statements for each organizational unit

Needs identified in this group were of two major categories. One set was aimed at general responsibility statements for all units of the organization while the other set was aimed at specific responsibility problems, like who is responsible for quality control problems with vendors. The negative aspects of responsibility statements were also commented on. These will jurisdictional problems and the identifications of certain projects with specific departures, rather than the whole division or company.

320 Planning and Design - Specific

321 Combine functions currently divided into Plant 1 and Plant 2 sections. Examples: Maintenance, Production Control, etc.

The statements made in this context identify problems of inconsistency in operation and problems of communications for functions split between the two plants.

322 Establish a composite facilities responsibility, combining Plant Security, Fire Protection, Maintenance, Plant Engineering, etc.

The perceptions reflect the idea of increased economy and effectiveness by developing a single functional responsibility for facilities.

323 Combine Quality Control and Quality Assurance Functions

The need identified reflects the difficulty resulting from having two groups with overlapping objectives but different apparent jurisdictional areas.

324 Establish a Materials Management Responsibility.

Statements in this category result from recognition of the benefits possible by combining the several responsibilities for materials in the organization.

325 Establish a systems and procedures function

Comments in this classification reflect the need for development of operating procedures, and standards.

326 Establish an Operations Research Systems Analysis Function.

A. General
B. Operations Research
C. Information and Control Systems Design
D. Electronic Data Processing

There was a general recognition of the needs for further development in the areas identified as Operations Research, Management Science, Information Systems, Control Systems, EDP Systems, Systems Analysis, etc. Many of the comments indicated a specific benefit from this general area of effort, some indicated possible problems that should be avoided.

327 Study of Operations Research applications outside of Manufacturing.

The statements indicate that the whole of the organization should be reviewed for OR applications. This should be done considering both the idea that OR applications are broad and cover more than one functional area, and that considering the total organization will provide means of justifying a truly significant movement in the direction of starting up an OR activity.

328 Manufacturing Research

The identifications classified in this group reflect a feeling that new manufacturing techniques should be reviewed and evaluated, then if they prove valuable, they should be implemented. This also includes developing plans for applied manufacturing research, that is, what are the problems, in what sequence should they be considered, and what approach should be taken in their solution?

329 Establish an Improvement Function

The perceptions supporting this grouping of needs center on the managerial problems associated with an improvement function. These are problems of selling improvement, coordinating efforts, selection of which improvement to pursue, developing an improvement oriented environment, etc.

330 Interaction

331 Programs for improved coordination and cooperation among line organizations.

The statements that indicate this need reflect the feeling that the line organizations do not always pull together toward common goals but may put personal or small group goals ahead of company or division goals. Other comments classified in this group reflect the relationship with the union concerning jurisdictional problems and shifting of people between plants.

332 Programs for improved coordination and cooperation among staff organizations.

The general impression given by this set of perceptions is that the participants felt that there were difficulties in getting problems solved when there was more than one staff group involved in the situation. Suggested solutions included creation of a coordinator position over all the staff groups, the use of inter-staff seminars, and formal communications describing what is being done, (including what the objectives and status are.)

333 Programs for improved coordination and cooperation between line and staff organizations.

Solutions are needed in two general areas, as noted by the comments, first, problems between the line and manufacturing staff departments. Secondly, problems between the line and other staff operations. Specifically, Industrial Relations was noted as the source of difficulties in union dealings.

334 Improved Relations with Marketing

Participants recognized the effect that knowledge of marketing information can have on manufacturing plans and activities. Also, it was recognized that marketing action can have significant affect on manufacturing results.

335 Improved Relations with Research and Development.

Like with marketing, the participants identified that R & D provides one of primary inputs to manufacturing. Restriction of communications between the two divisions has detrimental effects on both sides, but especially on the side of manufacturing.

400 Members

410 Planning

411 Manpower planning technique for predicting the time-phased skills and personnel requirements

The desired growth in the organization and the already considerable problems associated with manpower of all classes, indicated to the participants that it would be necessary to develop specific manpower plans in order to carry out some of the technical and productive plans of the organization.

412 A plan for organizational change due to retirements in the future.

Considerable concern was shown for the upcoming retirements of many of the key people. Participants felt that this was a critical problem and that plans should be made, specific activities such as training of successors started.

420 Selection and Development

421 A management selection program

The need for a technique to be followed in management selection was identified. Ideally, such a technique would consider all qualified people in the organization regardless of current location.

422 A selection technique for specific jobs. Example: inspectors

Inspectors were the only specific job where a selection problem was described, but any effort in this area could have wider application.

423 A technique for selecting individuals to participate in training program.

The two problem areas specified as contributing to this need are the problem of determining who needs what training for developmental reasons, and how to train enough men in critical labor skill areas within the restriction of the union agreement.

424 A management development program.

The participants identified that they felt a formal management development program is needed. Among other comments they identified that an informal program tends to lose out in the press of work and that there must be interaction between a developing manager and a successful manager so that the former can be exposed to some of the proper approaches and techniques, that cannot be gotten from classes or books.

425 A program of lateral transfer for development and job enrichment.

The need identified is related to the problem of developing people. The group felt that there was considerable opportunity for using the various activities and positions in the company for long term development activities. The net result, along with development, includes making the work more rewarding and stimulating.

430 Training

431 Training programs in management techniques aimed at line management, all levels.

This group of perceptions identify the need of training for all levels of line management, but the emphasis seems to be on the needs of the first line supervisor, who is dealing directly with the unit employees. Many of the possible benefits of such a continuing program were identified or implied.

432 Training programs aimed at staff personnel, all levels.

The requirements for management training of staff people was identified mostly in terms of those who are already managers, as compared to the related need for the line where the future or lowest level managers were singled out for training.

433 Training in meeting leadership for line management, all levels.

Relatively few participants identifies the need for line managers to be effective in meetings and in leading meetings.

434 Training in meeting leadership for staff personnel, all levels.

More participants saw a need for meeting leadership training for staff people than realized the same need for line people. The significant comments direct attention to the meetings not being results-directed.

435 Training in new technology for line management, all levels. Examples: OR, EDP, Manufacturing Technology, etc.

With the continuing technological developments, the need was identified that technical training must be provided to line personnel. The specific need identified covers all levels, from the worker to the upper levels of the line organization, but with different training needs existing at each level.

436 Training in new technology for staff personnel, all levels. Examples: OR, EDP, Manufacturing Technology, etc.

Many specific technical training needs are identified all of which are aimed at general need of technical training for staff managers and professionals. The reasons include prevention of technical obsolesence, off-setting shortage of available skilled people, making it easier for a manager to manage professionals, etc.

440 Membership Programs

441 Analysis of employee retention problems and development of a program.

The statements indicate that the participants felt that retaining the trained and experienced people already working for Company is a prime need for the organization. Specific comments were aimed at retaining professional people, especially the young, eager types who have good potential. The comments also indicated some of the underlying problems that cause people to consider changing jobs. Included in these are: lack of a challenging job situation, less than competitive salary, lack of promotional opportunities, limited possibilities for development of a strong professional image, etc.

442 Analysis of college recruitment problems and development of a program.

Problems that the company encounters in carrying out college recruitment activities indicated an area for improvement. The need is identified in terms of what the particular parameters affect a decision to join Company and a more general need to find out what types of things influence a college graduate's decision to work in industry and a particular company in industry.

443 Analysis of the problems of recruitment of experienced personnel and development of a program.

These perceptions indicated that all of the companies manpower needs cannot be solved by college recruitment and internal training activities but the company must also investigate the problems associated with attracting competent, experienced people to the company.

444 Technician program for production organizations. Technicians for highly skilled and technical jobs.

The need identified seems to be a direct result of the trend toward more complicated manufacturing equipment whose operating requirements would be outside of the incentive system and union agreement as it now exists.

445 Technician program for staff organizations. Technicians to assist professionals.

The technician need seems to be more acute in the staff organizations. The program as identified by these perceptions would seem to upgrade the professional's job, increase his accomplishments, and also serve as an incentive in retaining these people.

450 Effectiveness

451 Continuation and expansion of the Management Design activity.

Management Design was seen by all participants who commented to be a valuable program at Company. While some viewed the program as slowing down, all indicated it should continue, with some indicating the need for expansion of the activity.

452 Development of individual objectives and goals compatible with organization objectives.

The participants identified the need of members having goals and commitment to these goals for motivation purposes. The idea that these personal goals must be compatible with company goals was also stressed.

453 Measurement of individual performance bv comparing results to objectives.

The need identified is that of being able to evaluate an individual's performance in some manner that is meaningful to the organization.

454 Development of standards of performance for individual positions in the organizations.

These perceptions identify the requirement for performance standards by which an individual, or his superiors, can judge his performance.

500 Operational System

510 Planning and Control

511 Performance Measurement System:

A. General
B. Cost Control
C. Meaningful Output Measures (units)
D. Performance forecasting and tracking

The need identified reflects the importance of meaningful performance measures for the organization if the increased requirements for control are to be realized. Basically, the need consists of a requirement for a cost reporting and control system, which requires realistic criteria for measurement. Important uses to the organization are in providing information to management as to the status of the organization performance of individuals and groups and in predicting performance.

512 Manufacturing Improvement budgets with Improvement goals; evaluation of major cost areas in terms of improvement needs.

A. Improvement Budget
B. Evaluation of Improvement Needs

The needs identified here are apparently aimed at developing improvement goals in terms of a budget, thereby providing motivation to seek improvement. They also identify the need to develop practices to effectively evaluate where improvement possibilities are within the organization.

513 Study of equipment utilization and development of idle time costs.

The participants identified the need for decision making information concerning the utilization of fixed assets, specifically production equipment. It was identified that as the investment in automatic equipment goes up, it is advantageous to get maximum utilization of this expensive equipment, possibly through multiple shift operations.

514 Review of reports and paperwork for study of flow, duplication, effectiveness, etc.

The need here is for action to improve the flow of information that is transmitted by reports and other means of formal communication.

515 Evaluation of requirements for producing either or both high grade and low grade products on a given facility.

Company's present products are all of high quality, but the need identified is for evaluation of the effects of having several grade levels in the product line, all being manufactured in the same facility.

520 Motivation

521 Behavioral Science Studies:

A. Jobs Enlargement for staff
B. Analysis of absenteeism
C. Team approach in work simplification

Participants identified three possible specific behavioral science oriented studies. All of these are aimed at increasing the participation of the individual in activities vital to the organization.

522 New approaches to incentives:

A. General
B. Needs for new approaches
C. Use of EDP
D. Indirect
E. Multi-factor installation
F. New Maintenance Department technique

The need group identified covers the perceptions of the participants in the realm of the incentive system. The sub-headings indicate the range of specific comments.

530 Project Management

531 Project management techniques for planning and scheduling. Examples: PERT, CPM,

A. General
B. Project priority and coordination

The perceptions grouped in this need related to the problems resulting from the organization's having, at the same time, several different projects, perhaps in different departments, requiring planning and scheduling, and perhaps competing for common resources of money, equipment, and time.

532 Specific new product introduction or model change planning and scheduling technique.

The one type of project that is critical and repeats itself is that associated with new products or new model introductions. The participants identified the need to develop a general method of planning and carrying out this project, that can be used repeatedly.

533 Project Cost Analysis System:

A. Evaluation
B. Cost and manpower changes
C. Project status reports
D. Completion analysis

The need for better planning and scheduling of projects leads naturally into a control system covering the actual performance of the project. The need identified includes an analysis of the project when completed as well as status reporting while the project is current.

540 Quality Management

541 Quality Emphasis Programs:

A. General
B. Quality Standards
C. "Zero-Defects" type programs
D. Quality Incentives

The participants indicated the need for quality emphasis programs, that is, programs aimed at further developing the high quality orientation of the company personnel.

542 Quality Control Studies:

A. General
B. Facility and instrument requirements
C. Analysis Requirements

The technical requirements to the quality control activity are emphasized in this category of identified needs. These requirements would include data processing, statistical analysis, and mathematical analysis using the computer.

543 Cost-Quality trade-off technique and study of purchased parts rejection costs, and manufactured parts rework costs in relation to quality benefits.

A. General
B. Cost of quality
C. Cost-quality trade-off
D. Rejection-Rework Cost analysis

The perceptions made in this area identify that quality costs money and the organization can make better decisions if it knows or has some indication of the cost of quality.

550 Parts Management

551 Part Control:

A. Uniform number system
B. Bills of material on EDP
C. Specification change system

The general needs identified within this category reflect the problems of numbering that must be solved for effective use of EDP systems. They also reflect the problem that exists between major divisions of the company concerning changes in product manufacturing specifications.

552 Formal Make or Buy Analysis technique.

A specific technique for reviewing products for manufacture on a repetitive basis is identified as an important need of the organization.

553 Value Analysis

The need for and benefit from a value engineering approach are identified; the difficulties of establishing such an effort in the present company organization are also stressed.

560 Operations Optimization

561 Dynamic analysis of the manufacturing process:

A. Dynamic simulation of the entire system
B. Study of effects of production bottlenecks, changes in products, product mix, production levels, etc.

The need indicates that the analysis of manufacturing problems should be carried out as an analysis of the system on a dynamic basis. Simulation is one of the tools recommended.

562 Production Control Systems:

A. General
B. Uniform load measurement
C. Production load leveling(fab.and assembly)
D. Production scheduling (fab. and assembly)
E. Fabrication lot size determination
F. Work-in-Process Management
G. Workload forecasting, manpower requirements forecasting

The needs of the organization that are related to the Production Control System are grouped in this class. The individual items show a great deal of interdependence and work on one part would require consideration of the others.

563 Scheduling purchase parts considering vendor's production schedule and in-transit inventory.

Perceptions under this title indicate that by including the vendor and in-transit inventory in Company's production scheduling it might be possible to achieve significant economy.

564 Receiving report mechanization system

The need identified is the specific requirement for mechanization, via Data Processing, of the receiving system.

565 Inventory control analysis for raw material and purchased parts.

The general needs for improved inventory control techniques within manufacturing are covered in this category.

566 Optimal Coil Slitting Scheduling Model

The need for developing a means of optimally scheduling the coil slitting operation is indicated.

567 Assembly simulator model, including line capacity and balancing.

Identification of assembly scheduling problems and their resolution by simulation techniques is recommended by the perceptions grouped under this need category.

568 Assembly Line Balancing

The need for an analytic technique for balancing the work load among stations on an assembly line is identified by this need.

569 Marketing oriented studies:

A. General
B. Demand forecasting
C. Finished goods inventory control analysis
D. Finished goods warehouse automation
E. Service parts production and inventory control system
F. Distribution study - optimal warehouse location
G. Shipping planning and car loading
H. Obsolete service parts policy analysis

The interaction between marketing and manufacturing is the basis for the needs specified in this category. The participants recognize that the activities of the marketing organization have considerable effect upon the performance of manufacturing. The need for well thought out action in that Division is paramount, if the action affect, the productive workload. Close coordination between the two divisions in the areas covered by these perceptions is desirable and perhaps necessary.

570 Processing, Facilities, and Equipment Management

571 Specification standards for new equipment and facilities.

The need for equipment standards is identified in this category. Standards of this type are identified as being required to eliminate problems in installing and servicing production equipment and facilities.

572 Safety Standards

The need identified is the requirement for explicit direction to be provided for engineers, managers, and buyers in terms of the safety requirements for equipment and in the working environment.

573 Equipment Evaluation technique - capital investment analysis.

A major consideration is the evaluation of equipment when considering its purchase. This need includes not only the economic evaluation but the problem of predicting related equipment costs, and the nominal capacity of the resulting system. This nominal capacity may be less than rated because labor standard restrictions, or facility restrictions for example.

574 Maintenance Management System:

A. General
B. Maintenance Work Order EDP System
C. Equipment maintenance cost record EDP system
D. Equipment repair or replace analysis technique
E. Scheduling System for:
   Lubrication
   Preventive Maintenance
   Facilities Maintenance
F. Maintenance Forecasting

G. Maintenance supplied and repair parts inventory control analysis
H. Maintenance Engineering Data Depository

The perceptions that are grouped into this one general need are all related to the requirement for an approach to managing the maintenance activity in each of its many facets. Development of such a system would eventually include all the subheadings presented under this need.

575 Studies in space utilization, manufacturing container design, and storage facilities.

The needs grouped here have the common thread of being concerned with the physical handling and storing characteristics of the manufacturing system.

576 Central dispatching of material handling equipment.

The possible improvement due to central dispatching techniques applied to material handling equipment is identified by this need.

577 Tool control system:

A. Internal tool control
B. Subcontracted tool control
C. Tool repair prediction, repair priority assignment, etc.

The need for a tool control system is accentuated during change overs or when adding new products. The participants felt that the organization would benefit from the development of such a control system, along with development of related prediction capabilities.

APPENDIX 6

SCORING MODEL DEVELOPMENT

General

The purpose of the evaluation technique was to permit a group of participants to establish a numeric value for each need that would indicate its ordinal relationship to each of the other needs. The technique so designed follows the scoring model developed by Dean and Nishry (21).

The general technique was to develop a set of factors describing attributes of improvement needs. The evaluation team then rated each need in terms of these factors. These ratings, when evaluated using a set of weights for the factors, permitted the calculation of a numeric Opportunity Value for each improvement need considered.

Mathematical Formulation

The problem can be phrased as one of ranking or scoring a set of projects. This set of projects has the characteristic of being described by a set of factors, with the factors each having a different value to the organization.

Consider a set of m projects $\{i:1 = 1,2,3,\ldots,m\}$ that must be assigned ordinal scale values. Suppose that there are n factors $\{j:j = 1,2,3,\ldots,n\}$ that are considered by the organization to be of importance in determining the worthwhileness or value of the m projects.

The relative value of these n factors is described by an assigned weight for each factor, w_j $\{w_j:j = 1,2,3,\ldots,n\}$. Therefore, each of the n factors has a corresponding weight which is a measure of relative worth of that factor as it affects the value of a given project. The n component vector of weights is noted as w. Constraints on the values of the weights are:

$$0 \leqq w_j \leqq A$$

and

$$\sum_{j=1}^{j=n} w_j = A$$

where A = Normalizing Constant.

If the weights are determined from a ranking of factors, a basic weight unit, u is calculated and used to develop a factor weight in agreement with the ranking.

$$u = \frac{A}{S}$$

where S is the Sum of the rankings of the n factors

$$S = \frac{n^2 + n}{2}$$

The individual factor weight is then:

$$w_j = (n - r_j + 1)u$$

where r_j = the ranking value of factor j, (the highest ranking factor has value = 1, next highest = 2, etc. Ties are assigned an average for the tied factors; for example, a tie of 4 and 5 would result in each factor being assigned the value 4.5). Suppose also that for each of the n factors there are a set of p rating values $z_k \{z_k : k = 1,2,3,\ldots,p\}$, which for the problem at hand, are separated by uniform intervals. Then z_{jk} would indicate the k^{th} rating value for the j^{th} factor. These rating values are integer values, $z_{jk} = 1,2,3,\ldots,p$, in which the value is a measure of the amount or extent to which a factor is present. The maximum rating value is equal to p for all factors. The factor score $f_j \{f_j : j=1,2,3,\ldots,n\}$ is then the rating value for the factor multiplied by the factor weight:

$$f_j = w_j z_{jk}$$

The maximum possible score is B,

$$B = \sum_{j=1}^{j=n} w_j z_{jp} = \sum_{j=1}^{j=n} w_j p$$

which, because of the uniformity in the rating value is:

$$B = y_p A = pA$$

therefore,

$$A = B/p$$

The rating process consists of assigning a rating value for each factor for each of the m projects. The result is a m x n matrix identified as the Rating Matrix, Y, where each cell, y_{ij}, of the matrix contains a rating value z_k assigned by the organization to the j^{th} factor for the i^{th} project.

$$y_{ij} = z_k \text{ where } y_k = 1,2,3,\ldots,p$$

The total score for the i^{th} project is e_i:

$$e_i = \sum_{j=1}^{j=n} w_j y_{ij} = \sum_{j=1}^{j=n} f_j$$

In matrix notation:

$$e = \{e_1, e_2, e_3, \ldots, e_i, \ldots e_m\}$$

and

$$e = Yw$$

where:

e = m component vector of total scores, the i^{th} value being the score of the i^{th} project.

Y = m x n matrix of rating values

w = n component vector of factor weights where the j^{th} value refers to the relative weight assigned to the j^{th} factor.

APPENDIX 7

RANKING EVALUATION MODEL DEVELOPMENT

Participants and members of the evaluation team were asked to preference rank several different sets of data, at different stages in the study. There were three items of information desired from each set up ranking data, in general. The first was a consensus ranking that could be used to describe the whole set of responses. The second was to measure how closely a particular individual agreed with the consensus, and, thirdly, to identify groups of participants who generally agreed in their preference rankings, even though, as a group, they might disagree with the consensus. To accomplish these goals, it is necessary that some measure of distance be defined between rankings.

The algorithm developed is based upon the chapter "Preference Ranking - An Axiomatic Approach" found in Mathematical Models in the Social Sciences by Kemeny and Snell (24). Modifications to the approach have been made to permit computer manipulation of the data, but the basic axioms for the algorithm are unchanged.

The task of preference ranking is conceived with evaluating a set of items on an ordinal basis. Items in the set can be compared and a greater than, less than, or equal to relationship established between each pair of items in the set. The end result is an ordering of the items composing the set. For the purposes of this model, a ranking will be described by the assignment of integers to the set of items, unless there is an equality situation existing between two or more items. In that case, the tied items are each assigned the mean value of the tied ranking values.

The results of the ranking process in the study is a set of 69 preference rankings $R_p \{R_p : p = 1,2,3,\ldots,69\}$ each of which has n items $\{i : 1 = 1,2,3,\ldots,n\}$ that are in a fixed and known sequence. Each ranking R_p has a set of numbers, $\{r_{ip} : i = 1,2,3,\ldots,n\}$ one associated with each item. A constraint on these numbers is:

$$\sum_{i=1}^{n} r_{ip} = \sum_{k=1}^{n} k = \frac{n^2 + n}{2}$$

Typical rankings, for a three item situation, would be:

3, 1, 2

1, 3, 2

1, 2.5, 2.5

3, 1.5, 1.5

where in the last example item second and third in the standard sequence are tied for the first and second rankings.

The ranking for a specific participant, A, is identified as R_A and can be expressed as a matrix, also identified by A, where the elements of matrix A are equal to a_{ij} $a_{ij} : i, j = 1,2,3,\ldots,n$ and the value of a_{ij} is determined by the convention:

$$a_{ij} = \begin{cases} 1 \text{ if item i is preferred to item j} \\ -1 \text{ if item j is preferred to item i} \\ 0 \text{ if item i and item j are tied.} \end{cases}$$

this is equivalent to:

$$a_{ij} = \begin{cases} 1 \text{ if } r_{iA} > r_{jA} \\ -1 \text{ if } r_{jA} > r_{iA} \\ 0 \text{ if } r_{iA} = r_{jA} \end{cases}$$

As an example if $R_B = 2.5,\ 1,\ 2.5$, then:

$$B = \begin{bmatrix} 0 & 1 & 0 \\ -1 & 0 & -1 \\ 0 & 1 & 0 \end{bmatrix}$$

or if $R_C = 3,1,2$

then:

$$C = \begin{bmatrix} 0 & 1 & 1 \\ -1 & 0 & -1 \\ -1 & 1 & 0 \end{bmatrix}$$

The distance between two rankings, R_A and R_B is then defined as

$$d(A,B) = 1/2 \sum_{i,j=1}^{n} |a_{ij} - b_{ij}|$$

which, for the previous example, has a value of:

$$d(B,C) = 1$$

Kememy and Snell also provide a means of ascertaining the mean or concensus ranking. For a set of rankings (not necessary distinct), with matrices, Q_1, Q_2, Q_3,...,Q_q the mean is that ranking R_M for which

$$\sum_{i=1}^{q} d(Q_i, M)^2$$

is a minimum.

The model developed accepted two sets of rankings, the actual data set and a set of rankings to use in selecting the mean. The first set, R_p $\{R_p : p = 1,2,3,\ldots,q\}$ was the actual data set, the other, $\{R_p : p = q+1, q+2, q+3, \ldots, m\}$ is the set selected as possibly being close to the mean. These rankings were converted to matrices $Q_i \{Q_i : i=1,2,3,\ldots, q\ldots,m\}$ which were used to calculate a q x m distance matrix, D, where:

$$D = (d_{ij}) = d(Q_i, Q_j)$$
$$\text{for } i = 1,2,3,\ldots,m$$
$$j = 1,2,3,\ldots,q$$

Selection of the mean was then accomplished by calculating the sum of the squared distances for each mean as

$$\sum_{j=1}^{q} d(Q_i, Q_j)^2 \text{ for each } i, i=1,2,3,\ldots,m$$

and the minimum was selected as the initial mean. Then rankings close to these initial rankings were searched for selection of the final mean ranking, or consensus ranking. The distance from each individual ranking to the consensus ranking provides the measure of how closely that individual agrees with the consensus ranking. To develop groups of similar rankings, the program prepares a list of all matching rankings by selecting those with distances equal to zero from a given ranking. This provides the nucleus for a group of individuals with similar rankings. To provide nearby rankings a listing of rankings with a distance of less than or equal to two are then prepared for each individual. These are then inspected in relationship to the matching rankings and used for developing groups of individuals with similar rankings, regardless of their agreement with the consensus.

APPENDIX 8

REACHABILITY MODEL DEVELOPMENT

The model developed in this section was designed for analysis of the interpersonal contact information from the questionnaire. The desired result fell into three categories, indegree count, symmetrical relationship identification, and strong component memberships. The terminology and notation of Harary, Norman, and Cartwright in Structural Models: An Introduction to the Theory of Directed Graphs (31), was used as a basis for the development.

The answers to the questions that requested names of other members of the organization can be described as a line from the responder to the named individual. By coding individuals as nodes, a directed graph resulted from each question - answer set. The lines connecting the nodes being the relationships identified by the respondents. Let this digraph, or directed graph, be identified as D, then an adjacency matrix $A(D) = [a_{ij}]$ could be developed for analysis. This matrix, A(D), is a square matrix of dimension n where n equals the number of sets of respondent data, or 69 in this study. If the notation $v_i\{v_i : i=1,2,3,\ldots,n\}$ is used to denote the nodes or individuals in the graph, then a line representing individual i's identification of individual j is denoted v_iv_j. The entries in the adjacency matrix, a_{ij}, are then determined by whether or not v_iv_j exists or not in the digraph; $A_{ij} = 1$ if line v_iv_j is in D and $a_{ij} = 0$ if v_iv_j is not in D.

The indegree of an individual is then defined as

$$id(v_j) = \sum_{i=1}^{n} v_i v_j \text{ for } j = 1,2,3,\ldots,n$$

and is the number of incoming lines or, in other words, the number of times an individual has been identified by someone else in the organization.

The matrix of symmetrical relationships in the digraph D is noted as S(D). It is a square matrix of order n whose elemental value s_{ij} is equal to 1 if both $v_i v_j$ and $v_j v_i$ are in D; it is equal to 0 if only one or neither of the lines is present in D. S(D) can thus be used to identify which of the relationships being studied were reciprocal. S(D) is calculated by taking the element-wise product of the adjacency matrix with its transpose:

$$S(D) = A(D) \times A(D)'$$

For determining the groups of individuals who were in close relationship with each other as identified by the responses, a technique of identifying the strong components of the digraph was used. The first step is determining the distance matrix N(D) for digraph D. By definition, a distance matrix is a square matrix of order n whose elemental entry, d_{ij}, is the length of a geodesic from v_i to v_j. The geodesic is a path of minimum length from one point to another measured in the number of lines in that path. Therefore, d_{ij} takes on values of ∞ if v_i is not reachable from v_j; 0 if $v_i = v_j$; or some integer ≥ 1 if v_i is reachable from v_j. The distance matrix N(D) is constructed by first assigning the value of 0 to all d_{ij} where $i=j$; next for each element $a_{ij} = 1$, the assignment, $d_{ij} = 1$ is made. The $A(D)^2\#$ is calculated (where the symbol # indicatesboolean arithmetic) and each element, $a^2_{ij}\#$, $i \neq j$, is examined in regard to the corresponding N(D) element, d_{ij}. If $d_{ij} = 0$ and $a^2_{ij}\# = 1$, then d_{ij} is set equal to 2. This procedure is then repeated for $A(D)^3\#$, $A(D)^4\#, \ldots, A(D)^m$; replacing d_{ij} with $3, 4, \ldots, m$, respectively, if the existing d_{ij} is 0. The process is terminated at some level m, when $A(D)^m\#$ has an elemental value of 1 occurring only where there are already non zero entries in N(D). All remaining d_{ij}, $i \neq j$, that are equal to zero are replaced by ∞, indicating v_i is not reachable from v_j.

The reachability matrix, R(D) is then determined. It is a square matrix of order n, whose entries are denoted r_{ij} where $r_{ij} = 1$ is r_j is reachable from r_i and $r_{ij} = 0$ otherwise. It is calculated from N(D) setting $r_{ij} = 0$ if $d_{ij} = \infty$ and $r_{ij} = 1$ in all other cases.

The strong component matrix, T(D), is then calculated using the element-wise product of the reachability matrix and its transpose:

$$T(D) = R(D) \times R(D)'$$

A strong component of a digraph is a subgraph in which every member is mutually reachable; multiple strong components in a given digraph are possible. In the context of this study, a strong component would be subset or group of participants all in mutual relationship. The matrix T(D) is a zero-one matrix where $t_{ij} = 1$ only if v_i and v_j are in the same strong component. In this manner, the matrix T(D) can be examined to determine memberships in strong components.

If the above described algorithm is permitted to terminate, unique strong components are determined that would be directly relateable to the identification of groups within the organization based upon the criterion under study. However, some of the paths, which might be considered paths of possible idea flow, would be unrealistically long. To overcome this problem, a technique of truncation was established which limited the maximum value in the distance matrix to a parameter m which was arbitrarily chosen to be 2. The results of using this technique were excellent, for while the strong components identified were not unique, they were sufficiently restrictive to make it possible to assign participants to groups effectively.

APPENDIX 9

GROUP CORRELATION MODEL DEVELOPMENT

The Group Correlation Model (GRPCOR) is a program developed to analyze and compare the improvement need perceptions of groups of individual participants. This was undertaken in order to evaluate the perceptions of groups of participants and to determine if groups of individuals differed appreciably from one another in terms of what needs they perceived.

The program used a 80 x 69 perception matrix, M whose elements $m_{ij} = 1$ if individual j had identified need i and zero otherwise. Each column of this matrix corresponded to an 80 component individual perception vector p_i representing to the identifications of participant i. The input of group membership information, on each of k groups, then permitted the program to develop two different but related group perception vectors. The first vector was an 80 component zero - one vector z_k whose elemental values were either zero or one depending upon whether no one in the group or at least one in the group, respectively, had perceived the particular need corresponding to the vector element. This process resulted in a vector that was a composite of all individual perceptions and might be likened to the results of having the subset of participants actually working as a group.

The second 80 component vector, a_k, was an average perception vector whose elements were the simple arithmetic mean of the corresponding elements of the members of the group. This vector was more of a measure of consensus and emphasis than was the previous zero-one vector.

The analysis of these vectors was then carried out by calculating product-moment correlation coefficients for each set of group vectors. These were presented in k order correlation matrices, R and ϕ (for average and zero-one vectors, respectively) where elemental values were the correlation of group i with group j. Corresponding significance matrices were developed for each matrix, identifying when the coefficients were different from zero to the 1% and 5% levels of significance, as calculated by standard statistical tests (23).

The program also prepared machine readable output of both types of group vectors for evaluation by factor analysis. It also provided various printed information, including listings of needs perceived by the groups.

APPENDIX 10

STATUS MEASUREMENT DEVELOPMENT

One of the characteristics that was considered as having an effect upon the types of needs that an individual might perceive was his status in the organization. A program was developed to calculate a status index by a method proposed by Harary (32). The following material describes the method of calculating this index and is taken from an earlier paper by Reed (33).

Status was considered as positional status; that is, where a man is located within the organizational hierarchy and how many people are below him. This definition is due to Harary and is stated as follows:

Definition 1: The status $s(A_x)$ of a person A in an organization Θ is the number of his immediate subordinates plus twice the number of their immediate subordinates (who are not immediate subordinates of A) plus three times the number of their immediate subordinates (not already included), etc.

If the organization chart is modeled as a digraph with the directed line indicating the superior-subordinate relationship, a useful means of calculating the status number of an individual as well as the gross status number of the organization can be established. Several concepts from digraph theory are required:

Definition 2: A directed path from A_1 to A_n is a collection of distinct points $A_1, A_2, \ldots, A_n$ together with the directed lines $A_1 \rightarrow A_2$,

$A_2 \rightarrow A_3, \ldots, A_{n-1} \rightarrow A_n$.

Definition 3: The length of a directed path is the number of lines in it.

Definition 4: The distance from point A_i to A_j is the length of any shortest path from A_i to A_j and is written $d(A_i, A_j)$.

Using these definitions, the following theorem can be stated:

Theorem 1: The status of a point A_i can be determined by the following formula:

$$s(A_i) = \sum_{j=1}^{n} d(A_i, A_j)$$

where $j = 1, 2, \ldots, n$ covers the whole range of points in the digraph. The following definition makes possible a useful corollary:

Definition 5: The distance matrix for an organization or digraph θ, made up of members or points $A_1, A_2, \ldots, A_n$, is the matrix D whose i, j elemental entries are the distances d_{ij} where $d_{ij} = d(A_i, A_j)$.

Corollary 1-1: The status, $s(A_i)$, of member A_i is the sum of the elements in the i^{th} row of the distance matrix D.

The proof of this Theorem and Corollary are given in Harary (32) and will not be repeated here. The following definitions complete the development of status measurement:

Definition 6: Status of the organization as a whole is termed the gross status $s(\theta)$ and is calculated by the following formula:

$$s(\theta) = \sum_{i=1}^{n} \sum_{j=1}^{n} d(A_i, A_j)$$

or:

$$s(\theta) = \sum_{i=1}^{n} s(A_i)$$

Definition 7: The status vector $v(\theta)$ is the vector composed of the status numbers of each number of the organization, or:

$$v(\theta) = [s(A_1), s(A_2), \ldots, s(A_n)]$$

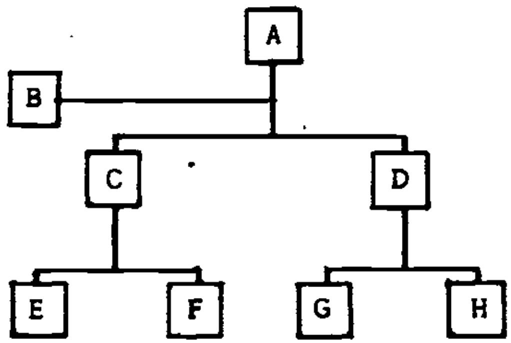
Definition 8: Relative status of a member, A_i, is denoted $s_r(A_i)$ and is calculated:

$$s_r(A_i) = s_r(A_i)/s(\theta)$$

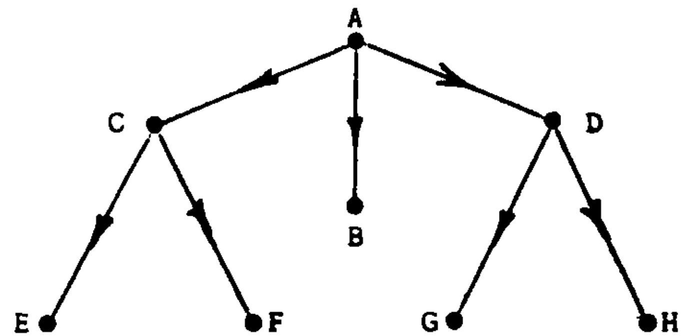
and

$$\sum_{i=1}^{n} s_r(A_i) = 1.0 = s_r(\theta)$$

The following example illustrates the determination of status numbers for a hypothetical organization.



Organization Chart



Directed Graph

$$
D = \begin{array}{c} \\ A \\ B \\ C \\ D \\ E \\ F \\ G \\ H \end{array}
\begin{array}{c}
\begin{array}{cccccccc} A & B & C & D & E & F & G & H \end{array} \\
\begin{bmatrix}
0 & 1 & 1 & 1 & 2 & 2 & 2 & 2 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}
\end{array}
$$

Distance Matrix

$s(A) = 11$	$s_r(A) = 0.74$
$s(B) = 0$	$s_r(B) = 0.00$
$s(C) = 2$	$s_r(C) = 0.13$
$s(D) = 2$	$s_r(D) = 0.13$
$s(E) = 0$	$s_r(E) = 0.00$
$s(F) = 0$	$s_r(F) = 0.00$
$s(G) = 0$	$s_r(G) = 0.00$
$s(H) = 0$	$s_r(H) = 0.00$
$s(\theta) = 15$	$s_r(\theta) = 1.00$

APPENDIX 11

CLUSTER ANALYSIS MODEL DEVELOPMENT

As part of the analysis of the participants and the improvement needs that they perceived, it was desirable to identify those individuals who had similar perceptions. The method used is given the generic term "cluster analysis" which identifies it as belonging to a broad set of techniques used to identify similar entities based upon the characteristics these entities possess. The attempt is to identify natural groupings of the entities so that these groupings, or clusters, can be used for some useful purpose of analysis, comparison, etc. The general concepts of cluster analysis can be found in an article by Green, Frank, and Robinson (34).

The general approach in cluster analysis is to determine a measure of distance between pairs of entities, and select the closest pair as the beginning of an initial cluster. The centroid for the cluster, the two entities, as then determined, and its distance from all unassigned entities is determined. The item closest to the centroid is then added to the cluster and the process repeated, calculating a new centroid and the distance from all unassigned items. This continues until the cluster reaches some arbitrary maximum number of members, or the distance between the centroid and the closest item exceeds some arbitrary maximum distance. Another cluster in then started (minimum distance pair of unassigned entities) and items added to it until it reaches the limits.

The process continues until all entities are assigned within the limits of the program.

Two different measures of distance were considered. The first treated each individual perception vector, p_k, $\{p_k : k=1,2,3,\ldots,80\}$ as defining the coordinates of a point in n-space where n = 80. The distance between two individuals, or vectors, d_{ij} is calculated as the simple Cartesian distance:

$$d_{ij} = [(p_{1i} - p_{1j})^2 + (p_{2i} - p_{2j})^2 + (p_{3i} - p_{3j})^2 + \ldots + (p_{80i} - p_{80j})^2]^{1/2}$$

The centroid $c_{i\ldots j}$ for $m\{m : m=1,2,3,\ldots\}$ points is then a function of the points $i,\ldots,j$ making up the centroid:

$$c_{i\ldots j} = \left[\frac{p_{1j} + \ldots + p_{1j}}{m}, \frac{p_{2i} + \ldots + p_{2j}}{m}, \frac{p_{3i} + \ldots + p_{3j}}{m}, \ldots, \frac{p_{80i} + \ldots + p_{80j}}{m} \right]$$

This method was tested extensively and found to be unsatisfactory for the present problem. The vectors considered here are zero-one vectors, with densities ranging from one non-zero element to 26 non-zero elements, with the mean vector having only approximately 11 non-zero elements out of the 80 possible. This resulted in distances between vectors that were very small and that were not a useful measure of closeness in terms of common identification of needs. The resulting clusters were without any strong underlying base of common need perceptions.

A second method was undertaken which proved to be of more practical value. The concept of distance was changed to one of matching perceptions. In the first method matching of perceptions and non-perceptions were considered of equal importance, with only the needs where one individual perceived the need and the other did not influencing the distance calculation. In this method the non-perceptions and the opposing perceptions were essentially ignored with distance being the number of matching perceptions. The change in the definition of distance also changed the cluster forming criterion to one of maximizing agreement rather than minimizing Cartesian distance. The centroid for these clusters was then described by a zero-one vector having elements of one only where all the members of the cluster had perceived the particular need. This method worked satisfactorily and resulted in identification of clusters with a controllable amount of agreement and consistency. As well as building clusters, it was used also to identify all individuals within a certain agreement level with a particular individual and to identify clusters of these individuals.

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VITA

Phillip Allen Reed was born in Oshkosh, Wisconsin, on February 6, 1934. He is the second son of Cynthia Elizabeth (nee Swallow) Reed and the late Howard Elton Reed. He attended public schools in Oshkosh and Lebanon, Wisconsin, and graduated from the Oconomowoc High School in Oconomowoc, Wisconsin, in June 1951.

He attended the Wisconsin State University at Oshkosh during the 1951-52 school year, enrolled in the pre-professional program. While at Oshkosh, he was a member of Lyceum Fraternity and served as its president during the second semester. The following year Mr. Reed entered the University of Wisconsin in Madison as a sophomore in Mechanical Engineering. He completed the elective option in Industrial Engineering within the Mechanical Engineering program and received the degree, Bachelor of Science in Mechanical Engineering, in February 1956. While an undergraduate, he was elected to membership in Tau Beta Pi (honorary engineering fraternity), Pi Tau Sigma (honorary mechanical engineering fraternity), Theta Tau (professional engineering fraternity) and was a member of the American Society of Mechanical Engineers and the American Society of Tool Engineers. During this program he was awarded the F. M. Young Award as outstanding mechanical engineering student, and served as president and secretary of Pi Tau Sigma and president and vice-president of Theta Tau, and was a member of the University of Wisconsin Rifle Team. Also, he received the National Scholarship Award from the

American Society of Tool Engineers as well as a scholarship award from the Madison Chapter of that organization.

On January 29, 1955, Mr. Reed was married to the former Jeri Kathryn Risley of Chenequa, Wisconsin, daughter of Mr. and Mrs. Russell E. Risley.

After completing his first degree, Mr. Reed entered in the graduate program at the University of Wisconsin. His thesis was entitled, The Effect of Side Rake Angle on Single Point Cutting Tool Pressures, and he was awarded the degree of Master of Science in Mechanical Engineering in August 1956.

He then joined Rex-Chainbelt, Inc., in Milwaukee, Wisconsin. After completing a company training program, Mr. Reed worked on a cost reduction program in the Methods Department and then as a project engineer in the Operational System Department. In this latter position he worked on the analysis and design of managerial control systems, primarily in production and distribution. During this period, he attended the University of Wisconsin-Milwaukee in the evening Master of Business Administration program.

In 1962 Mr. Reed joined the Lockheed-Georgia Company, part of the Lockheed Aircraft Corporation, where he was a Management Systems Research Specialist in the Advanced Computing Techniques Department. This was an operations research group and assignments were carried out in management information systems, forecasting, mathematical programming, simulation, and inventory management. During this same period, he was enrolled at Georgia State College in their Doctor of Business Administration program, and also served as a part-time instructor in statistics within the Department of Economics.

During these years, the Reed family was expanded from two to six with the births of Kathryn Jo, Gwendolyn Jane, Allison Joy, and Elisabeth Esther.

Mr. Reed entered the Georgia Institute of Technology on a part-time basis in the fall of 1964, enrolling in the doctoral program in Industrial Engineering. In 1965, he accepted a National Science Foundation Traineeship and continued his program on a full-time basis under the direction of Dr. Robert N. Lehrer, Professor and Director of the School of Industrial Engineering. During this time, he assisted in the development and presentation of several symposia on the Management of Improvement with Dr. Lehrer. While a graduate student, Mr. Reed was elected to membership in Sigma Xi (honorary research society) and Alpha Pi Mu (honorary industrial engineering fraternity).

In 1967 Mr. Reed was appointed Assistant Professor of Industrial Engineering at Georgia Tech and taught courses in the area of design of management information and control systems.

In the fall of 1968, he accepted an appointment with Purdue University as Associate Professor of Industrial Engineering, teaching the areas of systems analysis, operations research, and management analysis and improvement.

Mr. Reed is a Registered Professional Engineer in Georgia and serves on the Editorial Board for Production and Inventory Management. He holds memberships in the American Institute of Industrial Engineers, American Production and Inventory Control Society, The Operations Research Society of America, The Institute of Management Sciences, Simulation Councils, and American Society for Engineering Education.